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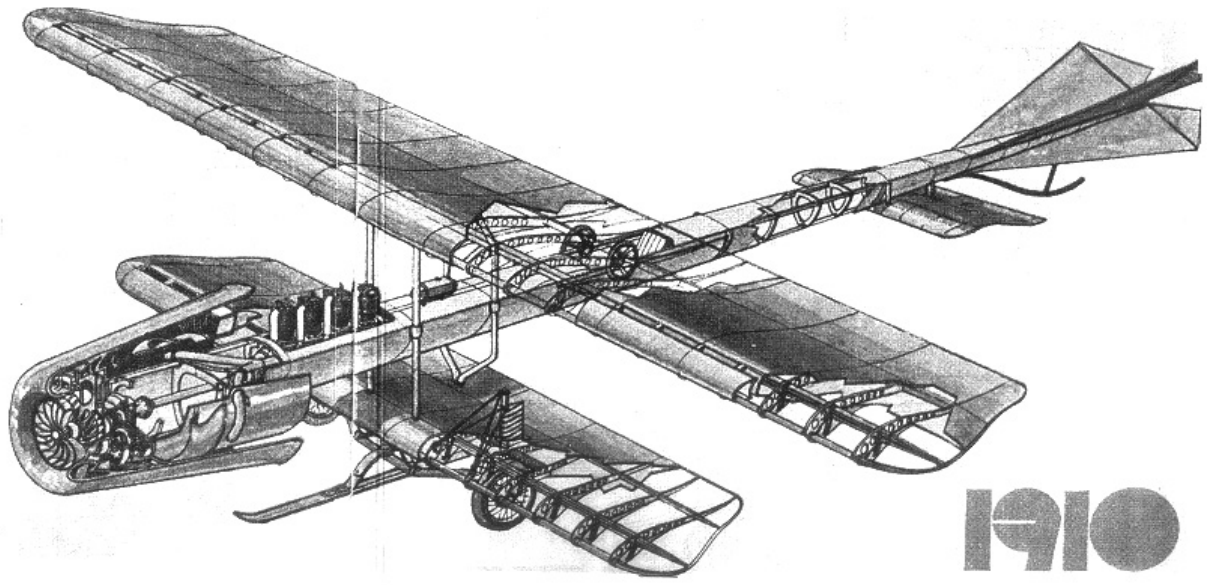

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C O N T E N T S

AIR TRAFFIC SAFETY MANAGEMENT IN WARSAW FLIGHT INFORMATION REGION

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Abstract: *Polish Air Navigation Services Agency(PANSA) is the only institution dedicated to manage the air traffic in the Polish airspace. While, fulfilling its' obligations in this regard, PANSA follows the principle of creating the most secure conditions for the flow of air traffic. What is more, provision of both en route and terminal navigation is aiming primarily at prevention of the incidents, which may contribute to a collision of aircraft. However, in the event of crash occurrence PANSA is also involved in the actions ensuring the fastest possible assistance to the victims. The indicator of PANSA effectiveness in the field of continuous improvement of aviation safety is the number of events reported annually to The State Commission on Aircraft Accident Investigation.*

Key words: *Air traffic safety management, PANSA, The State Commission on Aircraft Accident Investigation, SAR.*

1. INTRODUCTION

Air traffic safety management is one of the most essential project enabling efficient organization of air transportation of persons and goods. Main task connected with such challenge is to ensure safe navigation of the aircrafts.

It allows to maximize the utilization of available airspace by dynamic time-sharing, as well as the segregation of airspace among various categories of users. Moreover, traffic safety management is carried out by appropriately prepared institutions, equipped with specialized devices and highly skilled staff.

2. TASKS AND OBJECTIVES OF PANSA

Polish Air Navigation Services Agency (PANSA) commenced its operation on 1st April 2007, as an independent entity, separated from the structures of the State Enterprise "Polish Airports".

It was established under the Act on Polish Air Navigation Services Agency dated on 8th December 2006. [1]

At the beginning of its existence, PANSA took over the duties of Air Traffic Agency, organization previously responsible for management of Polish air traffic.

What is more, PANSA establishment was one of the first steps in the organization of the Polish air traffic structures according to the demands of the European Union law. [13]

The nature of activities carried out by PANSA (largely taking into account aspects related to the safety of air traffic) is defined and determined by Agency mission and the business direction.

The main role of the PANSA in the Polish aviation includes: *"To provide high-quality, user and environment friendly air navigation services"*.[8]

What is more, Agency emphasizes the desire to undertake the further development, which concerns: "*To strengthen PANSA's position in Europe as an economically competitive air navigation services provider offering top safety and quality services in response to the airspace users' expectations"*.[8]

Polish Air Navigation Services Agency, as an independently operating entity is a service provider that:

"ensure safe, continuous, smooth and efficient air navigation in the Polish airspace by carrying out the functions of the air navigation service providers, airspace management and air traffic flow management…".[1]

The essential purpose of the Agency's activities take into account projects related to safety, which allows:

1) to maintain high level of air traffic security,

2) to ensure required airspace capacity,

3) to minimize the negative environmental impact of air traffic,

4) to optimize cost efficiency.

PANSA activity is restricted by EU legislation to a large extent.

According to the basic principle of operation of air transport included in the EU regulations, the airport operation services should be separated from the airport air traffic control functions, and even more broadly defined air navigation.

Such principles arise primarily from the legislative package of the Single European Sky and a set of regulations called SES II (introduced in 2010) which clarifies the Agency areas of activity. [12]

3. WARSAW FLIGHT INFORMATION REGION

Polish Air Navigation Services Agency is a public body, which is supervised by the Ministry of Infrastructure and Development. [1] Moreover, the Agency is the only company providing services concerning air navigation in Polish airspace. What is more, PANSA operational area include Flight Information Region (FIR) Warsaw, which covers an area of 334 000 km^2. [3]

Each particular aircraft, located in the area of Warsaw Flight Information Region, is entitled to take advantage of full air traffic control service. This means that all possible steps are undertaken in order to prevent collisions that may occur both in the air and at an airport. Nevertheless, the main objective of the air traffic control service is to maintain an regular flow of air traffic in a controlled area. Polish controlled airspace includes:

- Airways, where air traffic control is supervised by the Area Control Center (ACC);

-Terminal Control Areas (TMA), where air traffic control is exercised by the Approach Control (APP), providing air traffic control service for arriving or departing aircrafts;

- Controlled Traffic Region (CTR), where air traffic control is provided by the Aerodrome Control Tower (TWR), providing air traffic control service to aerodrome traffic.

The scope of activities performed by PANSA includes all services, which are necessary for safe and precise conduction of Polish and foreign flights. However, in order to ensure that the safety of flight management services will be prioritized, the Act on Polish Air Navigation Services Agency foreclose the possibility of existence of the other companies engaged in similar tasks. According to this Act, the high level of security should be provided by Air Navigation Services (ANS) and other air navigation services, including: [1]

- communication service;
- navigation service;
- surveillance service;
- aeronautical information service.

Additionally, PANSA as an institution providing air navigation services, is committed to provide:

- provide airspace users with meteorological information;
- purchase, maintenance and modernization of equipment and systems for aeronautical communications, navigation and guarded airspace;
- controlling of systems for aeronautical communications, navigation and guarded airspace;
- conducting training and providing consultation in the field of air navigation;
- conduct research and development for air navigation;
- ensure the design of flight procedures.

Polish Air Navigation Services Agency, in the course of performed operational activity, pay particular attention to the existing safety standards. As can be expected, all of those standards are achieved as a result of maintaining and improving the safety of air traffic management system (ATM).

However, every step is undertaken in line with the policy of the international aviation organizations such as: ICAO, EUROCONTROL, as well as, European Union. Principal objective of those associations is to ensure that existing solutions, concerning the requirements of safety-related provision of air traffic management, are implemented at the appropriate level. [11]

In that case, PANSA implemented and continuously improve Safety Management System (SMS). The current management system aims primarily at assessing the possibility of avoiding the risk of air accidents and monitoring the whole phenomenon concerning the safety of ATM.

System also includes the investigation and explanation of the accidents which have a direct impact on the safety of air traffic.

Under this circumstances specific actions are implemented in order to prevent recurrence of such events. [8]

Polish Air Navigation Services Agency's actions undertaken in order to establish and maintain Safety Management System - SMS, are carried out in three main areas: [11]

1) Achieving the required level of utility safety, by: defining and documenting security standards and procedures, staff competency , risk management, collaboration with other internal and external systems.

2) Maintenance of adequate level of security through: reporting and investigating significant events affecting the safety and continuous improvement of services' quality to prevent from recurring of such incidents in the future, security monitoring, safety overview.

3) To promote safety, in particular including the dissemination of information regarding ongoing safety- related investigations, drawing conclusions from the resulting lessons (so called "lesson Learnt") and sharing best practices in this respect.

Another important task performed by PANSA is to coordinate any search and rescue activities in the air spaces of the Warsaw Flight Information Region.

Coordination of the Search and Rescue system (SAR system) by PANSA units allows to conduct air operations using properly trained, equipped and specialized Air Action Groups in the Polish Navy and Air Searching Group in the Polish Air Force. [15]

The main operating task of the SAR system is facilitation and improvement of activities including saving lives and health in the Polish zone of responsibility of Search and Rescue Region. [4]

Other important tasks realized by the aviation rescue forces also includes: evacuation of the wounded and injured, search and rescue, guidance other rescue units to the crash site, indication of the incident area and provision of the necessary equipment assistance. [5]

4. SAFETY LEVEL ASSESSMENT

The primary objective of air traffic safety management is to minimize the effects of incidents on the aircrafts and infrastructure used by PANSA for the provision of services, as well as limiting the negative consequences of events that have a direct impact on safety. According to the Regulation of the Minister of Transport dated 18 January 2007, all operational (ATM) or technical events (CNS - Communications, navigation and surveillance), which are relevant for the safety of air traffic, must be reported to The State Commission on Aircraft Accidents Investigation (SCAAI). [14]

After receiving notification of the occurrence of an air incident requiring the investigation, SCAAI Chairman appoints a committee, which conduct detailed analysis of the arose situation. In case of the circumstances under which safety investigation committee establishment in not required, the SCAAI Chairman inform interested parties, i.e. the user of the aircraft, the state traffic management authority (PANSA) or the aerodrome operator about undertaken decision and orders them to investigate to the event on their own.

However, at the same time Chairman nominates the person who will supervise the whole process on behalf of the State Commission on Aircraft Accident Investigation. [14]

On the other hands, in the event of accidents that do not meet the definition of an incident, but there is a possibility of their impact on the safety of air traffic, it is up to Polish Air Navigation Services Agency whether any steps will be undertaken.

Moreover, the examination of these events is usually performed without the supervisor of SCAAI.

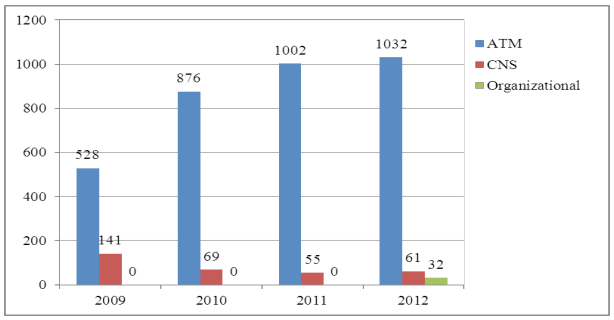

Fig. 1. Number of all ATM/CNS events reported to SCAAI between 2009 and 2012.

Source: Polish Air Navigation Services Agency's annual rapport from year 2012, Warsaw 2013, PANSA, p. 19.

The most common causes of ATM/CNS events, which are related to the safety of air traffic and according to the Regulation of the Minister of Transport dated 18 January 2007 should be reported to SCAAI include: notification of go-around situation, strikes of aircraft with birds and failures of the radio or navigation system supporting landing procedure in the conditions of poor visibility (so called: Instrument Landing system) in the Warsaw Region Flight Information. [12]

In the analyzed period covering the years between 2009 and 2012, the number of ATM/CNS incidents related to air traffic management, reported by PANSA to SCAAI, steadily increased (Fig. 1). In 2012, 1,125 ATM / CNS incidents were reported, and it was almost twice more than the number of accidents passed to SCAAI in 2008, when only 669 events affecting the safety of air traffic were noticed. A growing number of reported situations in the years 2009 - 2012, concerned the operational events (ATM), the number of which has increased from 528 in 2009 to 1,032 in 2012. However, at the same time, the number of technical events (CNS) has been reduced from 141 to 61 cases.

The increasing number of ATM / CNS cases reported to SCAAI, might indicate the declining level of safety of services provided by the Agency. However, it should be noticed that the increasing number of the air incidents reported to the SCAAI does not correspond to a number of events dedicated by the State Commission on Aircraft Accident Investigation to be investigated by PANSA itself.

Moreover, figure 2 clearly illustrates that between 2009 and 2012 number of events and incidents which had to be examined by the Agency decreased. For instance, in 2009, 54 ATM/CNS events and incidents were decided to be studied by PANSA, while in 2012 this number decreased to 20 only, of which 7 were ATM events, 6 were ATM incidents and 7 were defined as a CNS events. Thus, it can be unequivocally stated that the majority of reported cases did not meet the definition of an incident, therefore, SCAAI was not obliged to address requests for their examination to PANSA. Previously described situation is a direct results of the effect of the security system construction and growing awareness of the Agency's employees regarding the importance of creating even more efficient system in order to ensure the safety of air traffic. For this reason, PANSA employees more often report events which can influence the safety of air traffic. As a result, they contribute to the improvement of the existing system.

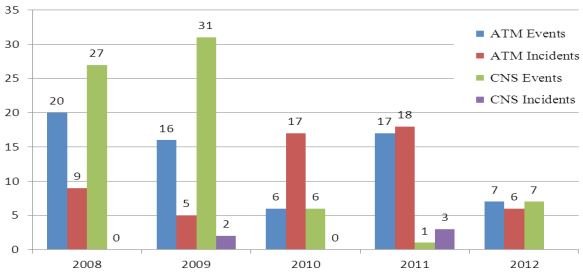

Fig. 2. Number of ATM/CNS events directed by SCAAI to be examined by PANSA between 2008 and 2012.

Source: Polish Air Navigation Services Agency's annual rapport from year 2012, Warsaw 2013, PANSA, p. 18.

While analyzing the frequency of events chosen by SCAAI to be studied by PANSA every year, it is important to notice a variety of reasons influencing their occurrence.

Fig. 2 presents ATM and CNS events, which include a significant amount of go-around situations and the collision of aircraft with birds.

Investigating the reasons for the events associated with go-around situations, it is possible to conclude that the main reason for their occurrence were the weather conditions.

Thus, the causes which are fully independent from the air traffic management services.

Fluctuations of the events number was largely conditioned by the intensity of snowfall and temperatures in winter and breaks in the weather during summer and spring periods. [8]

Furthermore, the increase of the air traffic in the Polish airspace influenced the final data to a great extent. During analyzed period of time, the number of registered commercial airline operations, both en-route and terminal, increased from 739 043 in 2009 to 879 126 in 2012. [6, 9]

5. CONCLUSION

To conclude, all aspects of PANSA activity as a provider of air navigation are related to projects improving security.

Thus, ensuring a high level of safety for all airspace users, performing flights in the Warsaw Flight Information Region, is the Polish Air Navigation Services Agency's highest priority.

In order to meet the current requirements certain activities are undertaken. Some of them include continuous efficiency improvement of the services responsible for the provision of air traffic safety.

Other activities allows Polish Air Navigation Services Agency to maintain a high level of safety and consistently raises the competence of personnel.

Moreover, PANSA adjusts its equipment, infrastructure, software and procedures used in air traffic management.

All undertaken steps ensure that Agency provides communication, navigation and surveillance services, which fulfill required standards that have been set by national and international law.

BIBLIOGRAPHY:

1. Act of 8 December 2006 on the Polish Air Navigation Services Agency.
2. European Commission, New Regulation on Single European Sky charging to make flying cheaper and more performing, December 2010.
3. European Organisation for the Safety of Air Navigation, Report commissioned by the Performance Review Commission, ATM Cost-Effectiveness (ACE) 2011 Benchmarking Report with 2012-2016 outlook, Brussels 2013.
4. International Convention for the Safety of Life at Sea (SOLAS), London 1974.
5. Karpowicz J., Ratownictwo lotnicze, AON, Warszawa 2003.
6. Kucharek D., Aspekty ekonomiczne zarządzania ruchem lotniczym w Polsce, Dęblin 2014, WSOSP.
7. Obwieszczenie Nr 5 Prezesa Urzędu Lotnictwa Cywilnego z dnia 16 kwietnia 2014 r. w sprawie ogłoszenia tekstu Załącznika 19 do Konwencji o międzynarodowym lotnictwie cywilnym, sporządzonej w Chicago dnia 7 grudnia 1944 r.
8. Polish Air Navigation Services Agency's Annual Rapport from year 2011, Warsaw 2012, PANSA.
9. Polish Air Navigation Services Agency's annual rapport from year 2012, Warszawa 2013, PANSA.
10. Polish National Supervisory Authority, Polish Performance Plan 2012-2014, Warsaw, 2011.
11. Record of the meeting of the Committee of Infrastructure (No 28) of 26 April 2012, the Sejm Chancellery Office of the Parliamentary Committee, Warsaw 2012.

12. Regulation (EC) No 551/2004 of the European Parliament and of the Council of 10 March 2004 on the organization and use of the airspace in the single European sky (the airspace Regulation).
13. Rozporządzenie Ministra Transportu z dnia 18 stycznia 2007 roku w sprawie wypadków i incydentów lotniczych (Dz.U. z 2007 r. Nr 35, poz. 225).
14. Truskowski A., Lotnictwo Marynarki Wojennej RP w nowych uwarunkowaniach strukturalnych, Lotnictwo nr 6 z 2011 r.

INTEGRATED AVIONIC SYSTEM SPECIFIC FOR AIR TRAFFIC SAFETY

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Abstract: *Traffic Alert and Collision Avoidance System (TCAS) obtains flight data from the barometrical altimeter on board, directly from the altitude encryption device or from an aerodynamic air data base which contains information regarding: altitude, vertical speed and the altitude of any unknown aircraft which can be considered a foe/enemy. Our suggestion is to have satellites aiding the navigation system in collection of data: position, direction, speed etc.*

Keywords: *TCAS, transponder, adding machine, traffic advisor, resolution advisor*

1. INTRODUCTION

Air traffic is in a continuous expansion, helped by the development of monitoring and control systems, leading to a satisfying flight safety.

Despite the technical advances and pilot training the risk of air collisions still exists, furthermore a series of catastrophes took place in the USA:

- in 1956, the collision of two airplanes above the Grand Canyon ;
- in 1978, the collision between a light airplane and commercial airliner above San Diego;
- in1986, the collision between a DC-9 and a private jet in Cerritos.

The catastrophe from 1978 was the premises for the initiation and development of **TCAS** (Traffic Alert and Collision Avoidance System).

TCAS is radio electronic equipment which functions on the second principle of radiolocation, communication between two or more airships found in a possible traffic conflict, with the help of widgets named transponders (with the condition that the transponders are activated and configured properly).

2. THE OPERATIONAL PRINCIPAL BEHIND THE COLLISION AVOIDANCE SYSTEM

Along with TCAS the ICAO organisation (International Civil Aviation Organisation) has been developing, starting with the 80s, standards for ACAS (Airborne Collision Avoidance Systems) [1].

ACAS is programed to think independently of the on board navigation system as well as of the ground systems used for carrying out air traffic services. The signature component specific for ACAS (proposed by Dr. John S. Morell in 1955), does not function on the elemental distance but on the elemental time. After a set of replies, ACAS basically calculates the time in order to limit CPA (Closest Point of Approach) , making a ration between distance and speed approach [1].

If the intruder transmits his altitude, ACAS will calculate the precise time when the airships will reach the same altitude.

Referring to these systems (since 2009) only TCAS is in accordance with the ACAS standards of ICAO, more specifically TCAS II v7.0 (produced by Rockwell Collins, Honeywell and ACSS) .

TCAS III was scheduled to present the new generation in collision avoidance equipment [2,3] .

TCAS III was an update for TCAS II, and could fix traffic situations using manoeuvres even on a horizontal plan, which would increase the distance between airships.

Civil airships carrying a turbine motor and with a capacity over 30 people, flying in USA air space must be equipped with TCAS II.

Since 1993 the number of long flight airships equipped with TCAS II grew, even though in EUROPE this equipment was not mandatory

Studies and evaluations over time showed an increase in safety offered by TCAS II. In 1995, EUROCONTROL *Committee of Management* approved a implementation policy and a program for the mandatory use of ACAS II in Europa.

This was ratified by the *European Air Traffic Control Harmonisation and Integration Programme* (EATCHIP) [4].

The working principal of CAS (Collision Avoidance System) is predictable and is being developed in two different directions: sensitivity and warning signalling.

Sensitivity is reported to altitude and represents the level of protection. Signalling time is centred on time till CPA (Closest Point of Approach).

Signalling time also includes supplementary protection in distance for close range calls. TCAS obtains flight data from the barometrical altimeter on board, directly from the altitude encryption device or from an aerodynamic air data base which contains information regarding: altitude, vertical speed and the altitude of any unknown aircraft which can be considered a foe/enemy.

When the airship is below 1700 feet, TCAS's algorithm calculates the position of the intruder ship using the on board barometrical altitude and radio altimeter as well as the barometrical altitude of the intruder ship.

If the now dangerous airship is below 380 feet the TCAS will consider it on ground (fig.1).

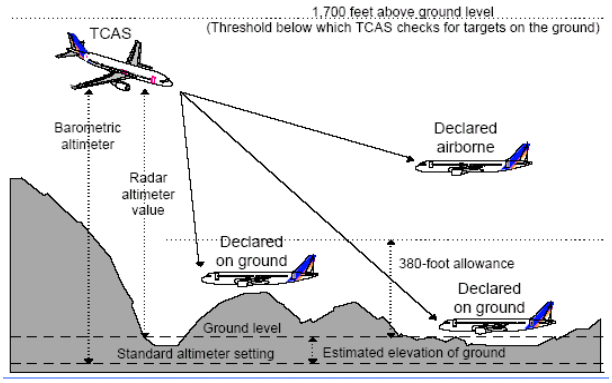

Fig.1 Target on-the-ground determination [Eurocontrol – ACAS II Training Brochure]

3. THE STRUCTURE OF THE COLLISION AVOIDANCE SYSTEM AND THE PROPOSED MODEL

After the presented models the TCAS has the components: (fig.2) :

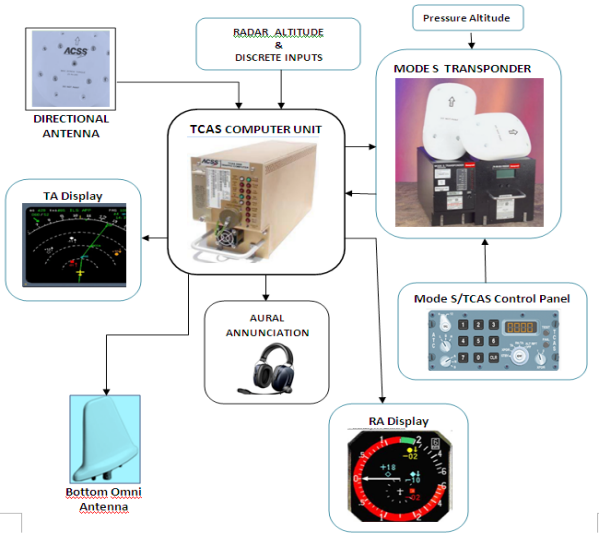

Fig. 2 Simplified block scheme of the TCAS system

- a computer
- TCAS control panel
- Two antennas – one mounted in upper side of the fuselage and the second in the lower part.
- Connection with a transponder S mode ;
- Connection with the altimeter – to obtain the barometrical altitude; or ADC (Air Data Computer) if equipped;

- Connection with the radar altimeter – to restrict the radar altimeter when close to the ground and to see if the followed ship is on the ground;
- Audio systems – acoustical awareness;
- Display – to display the information.

The awareness signal systems emanated by ACAS depends on the mode in which the transponder is programmed during a conflict flight [3,4]:

- lack of awareness signal if the transponder is not functional, broken or not synchronized with the ICAO standards;
- TA (Traffic Advisory), in order to warn the pilot for foe visual identification;
- RA (Resolution Advisory), are manoeuvres indicated to the pilots, only if the transponder reports the altitude.

To determine the distance and altitude, the airship identifies itself in a Cartesian coordinate system.

$$(s_n)_t=\left[(s_n)_{x,t};(s_n)_{y,t};(s)_{a,t}\right]^T \quad (1)$$

3D position equation for the airship n and

$$(w_n)_t = \left[(w_n)_{x,t};(w_n)_{y,t};(w)_{a,t}\right]^T \quad (2)$$

the 3D express of the speeds, where *x, y* represent the horizontal system of the axes and a represents the altitude. Our proposal implies that the coordinates of the airship should be determinate with the help of satellites, thus eliminating the possibility of errors.

A scheme of the proposed system could be presented in the next form:

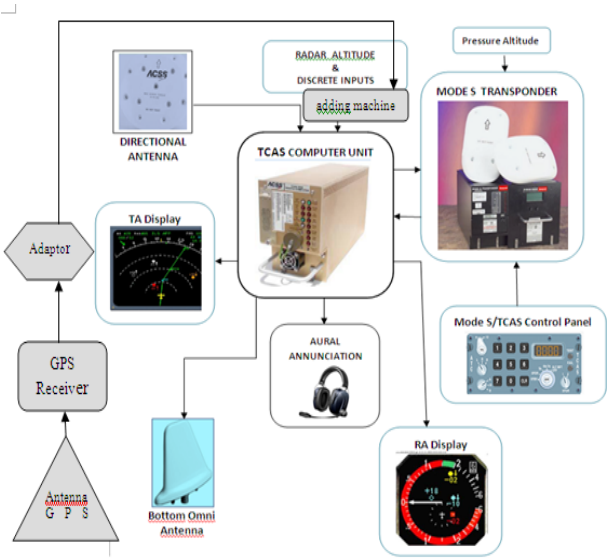

Fig.3 Simplified block scheme of the TCAS system with a GPS system

Position signals, speeds, trajectory directions for each airship are taken over and processed the following command line: Antenna-GPS receptor – Adaptor, applied to a device where the errors referring to the barometrical altimeter could be valuable.

4. CONCLUSIONS & ACKNOWLEDGMENT

Over time there have been concerns referring to the TCAS system's opportunity.

It has been hypothesized that airships equipped with TCAS might trigger a domino effect.

The appearance of circumstance refers to the vertical movement of two airships as a result of the RAs emitted by TCAS would trigger a conflict with a third forcing it to deviate from its course and propagating the domino effect.

The introduction of an additional channel, this being our proposal the correction through GPS with the possibility of informing the airships in the possible danger zone and future navigating intentions, we could significantly reduce both collisions and their premises.

BIBLIOGRAPHY

1. ICAO-*Airborne Collision Avoidance System (ACAS) Manual* First Edition — 2006

2. Annex 10 of ICAO - Aeronautical Telecommunications - Volume IV – "*Surveillance Radar and Collision Avoidance Systems*"

3. Doc. 4444 of ICAO - PANS-RAC – "Procedures for Air Navigation Services – *Rules of the Air and Air Traffic Services*"

4. RTCA SC-147 / DO-185A - Minimum Operational Performance Standards for Traffic Alert and Collision Avoidance System (TCAS) Airborne Equipment

SLEEPINESS AND SLEEP APNEA IN AVIATION – MEDICAL APPROACH

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Abstract: *Everyone knows the cognitive and performance related effects of fatigue: lack of concentration, forgetfulness, inability to determine priorities or make decisions. Flight crew members are well aware that efficiency of performance under these conditions - sleepiness and sleep apnea - is significantly decreased and presents high threat to flight safety. The determination of "fitness to fly" for aviators with sleep disorders can be verry difficult because we could not obtain coherent information about fatigue from current aeromedical guidelines. Majority of air organisations do not provide any helpful somnological assistance. Evaluation of medical requirements for pilots needs partnership. This paper presents the first step of the author's efforts to promote the implementation of a fatigue risk management system (FRMS) in Romania – a treatment algorithm in sleep apnea .*

Key Words: *Fatigue, Sleepines, Sleep apnea*

1. INTRODUCTION

If the diagnosis of a sleep related breathing disorder in aviators has been done step by step, in case of necessity a treatment has to follow.

This has to be done by a stepwise proceeding as well, dependent on the graduation of the disorder and the collateral diseases.

Step one contains the general recommendations, step two pharmacologic approaches and step three mechanical methods.

2. GENERAL RECOMMENDATIONS

Anytime helpful and in less severe cases salutary is the sanitation of obstructed upper airways by otorhinolaryngologic treatment, e.g. surgical therapy of a ronchopathy or a relevant septum deviation, of adenoids or enlarged tonsils, sometimes a cautious resection of pharyngeal tissue.

Also the stabilization of a lax epiglottis can be reasonable. An otorhinolaryngologic examination in every patient with nighttime breathing problems is mandatory. Naturally concomitant pulmonary and cardiovascular diseases have to be treated consequently.

In moderate cases this can lead to disappearance of the sleep related breathing disorder yet.

For example a sufficient pharmacological therapy of heart failure can heal Cheyne-Stokes ventilation, and as a mild obstructive sleep apnea can be generated by the hydropic congestion of neck tissue in heart failure, it may disappear if the latter is treated successfully.

An important general recommendation is the loss of weight. There is a strong correlation between body weight and severity of sleep apnea.

However, an adequate weight reduction sometimes is able to heal the patient from his breathing disorder, but in each case it is helpful to optimize the other therapies, which normally only operate symptomatically.

Every kilogram counts, as fat depots in the neck region being relevant for the obstruction of extrathoracic airways are reduced in the early phase of fasting. Men should be requested to reduce their neck circumference under 43 cm, marking the border of pathologic snoring. We all know the difficulties of the most people in reducing their weight, but we should not stop to mention it.

Procedures of sleep hygiene are meaningful in every sleeping disorder. This contains some simple but important actions like abandonment of late and opulent meals or late elevated consumption of alcoholics.

Hypnotics of the benzodiazepine group should be avoided with respect to their relaxation effect to the muscles.

Self-evident the sleeping room should be well aired and not too much heated.

On the other hand a too cold bedroom is adverse, too, ideal are 18-22^0 Celsius. Sport of course is a good and healthful activity, but in the last two hours before going to bed it can destroy the sleep quality.

And the quality of the mattress also plays an important role for the quality of sleeping. All mattresses have a life expectance of 8-10 years, after that they have to be changed.

The only exception is the water mattress, showing the necessity of change by a puddle. A big problem for aviators patients with sleep related breathing disorders is shift working.

If even healthy shift workers having reached the fourth decade of life have difficulties with the timely resynchronization of day-and-night rhythm, then those with sleep disorders of any kind and any age are absolutely unable for this and risk a severe impairment of their vigilance and health. Hence patients with sleep disorders should resign from shift work as fast as possible.

This applies for sleep related breathing disorders as well. As banal the rules of sleep hygiene may be, as important it is to discuss them with the patients.

These rules not only are valid for sleep related breathing disorders, but generally for all sleep disorders, and should be respected by all humans on behalf of a good, healthy sleep.

3. MEDICATION

There have been many attempts to treat sleep related breathing disorders by a pharmacological approach, but most have failed. Successful is only the treatment of mild postmenopausal obstructive forms in women with estrogen-gestagen combinations, which enhance the muscle tone and thus help to keep open the airways.

But this therapy only works in less severe cases and includes the necessity of a careful observation of the patient due to an incidence increase of hormone dependent gynecologic tumors.

This is the reason for refusal of this approach by many experts. In the textbooks of sleep medicine the application of retarded theophylline is often recommended in patients with snoring or mild sleep apnea.

The mechanism of working in nighttime airway obstructions is not known at last, postulated is an effect of toning up of muscles.

Using theophylline the AHI can be reduced by app. 25 %, which reduces its inset on mild forms of sleep related breathing disorders.

It is known that the effect disappears after 1-2 years of usage. The major effect of theophylline is probably reduced to its central stimulating effect. Therefore the reduction of snoring is bought by a reduction of sleep quality, and the passing effect is a consequence of adaption, like one can adapt to coffee consumption in the evening.

Today it no longer has any relevance in the modern treatment of sleep related breathing disorders. In about 10 % of the patients the daytime sleepiness persists despite an optimal treatment of the breathing disorder.

The causes are not yet well analysed today, it depends most likely on a central nervous damage, which is the consequence of longtime nighttime oxygen desaturations, and which does not allow the patient to reach his premorbid vigilance level despite an optimal therapy.

In these cases the option of treatment with vigilance augmenting substances is given.

Having had only the amphetamines quite recently, which include the risk of addiction and relevant side effects, now we can use modafinile, a substance stimulating selectively the central vigilance centers without any intolerable side effects.

With a dosage of 100-400 mg daily it is licensed for the therapy of persisting sleepiness despite optimal treatment in sleep apnea patients, beside this in the treatment of narcolepsy and shift workers syndrome.

4. MECHANICAL THERAPY

The device based treatment can be divided on the one hand in oral appliances with the target of dilatation of the upper airways, which naturally only can be used in obstructive forms of breathing disorders, and on the other hand in the mechanical breathing support treatment, which represents the therapeutic gold standard.

4.1. Oral appliances

Already 1934 Pierre Robin tried to treat the disease named to him with an intraoral monobloc appliance.

The real history of oral devices started in 1982 with the tongue retainer built by Cartwright. The operating principle of every oral appliance is the opening of air space in the oropharynx, the ways used to reach this target are different.

There have been many experiments with tongue retainers, pelottes and tongue protrusors.

All these did not prove themselves. The breakthrough was done in 1984 by the neurologist Meyer-Ewert, who with the assistance of a dentist constructed a device, which according to the example of the Esmarch-

Heidelberg maneuver well known from the emergency medicine (to open the airways of an unconscious person) protracts the lower jaw and by this opens the pharyngeal airways.

This idea was modified and improved in the following years and decades.

The recent used appliances firstly were constructed in 1996 by the German orthodontist Hinz, who himself was suffering from a sleep apnea. In the meantime the devices were improved continuously.

Today there are two devices which have showed their efficiency in studies: The IST device by Hinz - (fig 1) and the Thornton Adjustable Positioner (TAP) – fig 2.

The principle of operating is the protrusion of the lower jaw for app. 60-70 % of the possible protrusion, and a dental opening of app. 5 mm, leading to an opening of the posterior airway space.

Fig. 1: *IST®-plus by Hinz. The splints are connected by attachments allowing to open and move the mouth.*

Fig. 2: *Thornton Adjustable Positioner (TAP®). The mandibular protrusion is achieved by hooking the upper jaw's splint in the lower jaw's splint.*

Oral devices are able to stop snoring, but they reduce the AHI only by app. 50 %, so that they are not therapy of choice for severe cases.

But in pure snorers they work well, and for sleep apnea patients with an AHI up to 25/ hour they can be a good and more comfortable alternative to nCPAP application. The range of response is only app. 70 %, because the obstruction of upper airways can be on different levels which cannot be antagonized by mandibular protraction, and there are no good predictors of response.

Today it can be tested with inexpensive thermolabile boil-and-bite devices, which predict quite well the effect of oral devices. But, the thermolabile appliances may not be used for any length of time being able to bring the teeth to move. As mentioned above, the application of oral appliances should be constrained to pure snorers and less severe cases of obstructive sleep apnea. Only in rare cases of severe sleep apnea a treatment attempt is justified, if a patient at least cannot accept nCPAP therapy, or in addition to nCPAP, if this alone is not able to break the airways obstruction. Before application a thorough dental examination is necessary. To estimate the anatomy of the facial cranium and tissue, a lateral cephalometry has to be done, the appraisal of the jaw links minimum needs an orthopantomogram.

Precondition for treatment with an oral appliance is a nearly intact denture, not less than four pillars (or implants) in each jaw are needed.

General contraindications are body weight more than 150 % of normal, epilepsy and too small stoma (e.g. in scleroderma). Severe diseases of the jaw links, denture in need of rehabilitation, profound periodontosis or toothless jaws are additional contraindications.

Side effects are rare and mostly transient, like increased salivation and morning lockjaw.

Real severe side effects like change of teeth location or gingival problems are described but very seldom.

Naturally the effect of oral devices has to be controlled by polygraphy or polysomnography, also in the long run, except in social indication of habitual snorers, where the appliances are well effective and a good chance to recover the bedroom's peace.

4.2. Mechanical breathing support devices

In 1981 the Australian Colin E. Sullivan firstly presented nCPAP therapy for treatment of obstructive sleep apnea. nCPAP is denoting "nasal Continuous Positive Airways Pressure" and thus means overpressure air insufflation to the upper airways using a nasal mask.

Until today this still is the gold standard treatment of obstructive sleep related breathing disorders. Having been as big as a refrigerator and producing noise like a strong vacuum cleaner in the early eighties, today the machines have the size of a lady's handbag and are hardly to hear.

Fig. 3: *Patient with nPAP device.*

The principle of nCPAP therapy is not ventilation, but pneumatic splinting of the extrathoratic airways, thus effectively being the same mode of action as tracheal intubation.

In obstructive forms of sleep related breathing disorders it works well due to undisturbed breathing action.

In central breathing injuries nCPAP is less helpful, here a real ventilation therapy is indicated, so called NIPPV (Non Invasive Positive Pressure Ventilation). This technique, similar to the ventilation methods being used in intensive care units, today can be applied at home via nasal masks.

Effectiveness of nCPAP is well documented scientifically. It not only suppresses nighttime breathing disturbances, but restores quality of sleep, so that the patient's daytime condition recovers. The usually applied mask pressures range between 4 and 14 mbar, in case of a higher need of pressure or in patients with severe pulmonary or cardiac diseases a BiLevel device should be used. This machine is able to detect in- and expiration of the patient using a pneumotachygraph, and lowers the mask pressure in the expiration phase. On the one hand this enhances the comfort of the appliance, because the patient has not to expire against a high mask pressure, on the other hand it unburdens the heart and bronchial system.

Contraindications against nCPAP and nBiLevel are tumors of the nasopharyngeal space, a not surgical reconstructed lax epiglottis and deficient cooperation of the patient, as the devices are too expensive for collecting dust unused.

Side effects do happen, mostly nasopharyngeal mucosa problems by the insufflation of cold and dry air, which can be treated with a heated humidifier.

Other complications are very rare. The required mask pressure has to be evaluated and fixed in the sleep laboratory using polysomnography.

Its level depends of a lot of factors like body weight, sleep phases and body position.

In patients with varying need of mask pressure during the night today it is possible to use an automatically, self-titrating nCPAP appliance.

5. CONCLUSIONS

In summary, oral devices are, in the case of accurate, censorious application, a fine and in addition inexpensive treatment option for less severe cases of obstructive sleep related breathing disorders, in which nCPAP devices are not yet clearly indicated.

Usage and quality of adjustment have to be controlled periodically, generally yearly with ambulatory cardiorespiratory polygraphy, in case of abnormalities via cardiorespiratory polysomnography in the sleep laboratory.

Evaluation of medical requirements for pilots needs partnership.

BIBLIOGRAPHY

1. American Sleep Disorders Association Standards of Practice Committee. Practice parameters for the treatment of snoring and obstructive sleep apnea with oral appliances. Sleep. 2005.
2. Ştefănescu, C.D.; (2009). Ghid de Somnologie aeronautică. Editura Centrului Tehnic – Editorial al Armatei; Bucureşti-2009; ISBN 978-606-524-051-3.
3. Ştefănescu, C.D.; (2013). Day surgery procedures for snoring. The revue of Aeronautical Medicine and Psychology (17) No. 1(62) pp 53/103.
4. Punjabi NM. The epidemiology of adult obstructive sleep apnea. Proc Am Thorac Soc 2008;5:138–140

SECURITY AND NATIONAL DEFENCE FUNDAMENTAL INTERESTS IN ALLIED CONTEXT

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Abstract: *Some of the fundamental national interests including national security and defense tend to gain more importance and make the transfer to the defense and collective security imposed by intergovernmental organizations, the representatives of globalization. Most states of the EU are also members of the NATO, therefore the collective defense and security problem have to be studied and watched through the principles and complementary actions of the two organizations.*

Keywords: *state, national interest's, fundamental values, national security and defense, collective defense, globalization, security system, security environment.*

1. INTRODUCTION

Speaking in the present tense of the Romanian national state existence, when we have full NATO and European Union membership, the national interest's issue of national defense and security is solved by the security and Euro-Atlantic defense policy system.

This fact does not diminish Romania's efforts to contribute to the collective effort of security and defense and to show that it is a security provider in the membership context of the alliance.

The items considered for implementation of Romania's full integration in these two organizations are represented also in the European security strategy starting with the European Security Strategy ''A Secure Europe in a Better World ", 2003, The EU Internal Security Strategy – "Towards a European Security Model", 2010, The Europe Strategy 2020 - "A European strategy for a smart, ecological and convenient for the inclusion, growth", 2010, and the current NATO strategic Concept "Active engagement, Modern defense" adopted by the heads of state and government at the NATO Summit, Lisbon, 2010.

The national aims are to optimize the national efforts to respect the allied and community commitments.

It is necessary to take into account that the efforts are developed in terms of promoting democracy and human rights, ensuring the primary needs of the population, energy security, promoting stability and peace in the neighborhood of the Romanian state, developing the necessary national defense and successful participation capability in allied activities, reducing the number of possible threats and the number of Romanian vulnerabilities and also adapting the security institutions to the allied and community requirements.

The South-East security environment, area where Romania is situated is affected by the following risks and vulnerabilities: "frozen" regional conflicts; weapons of mass destruction; international terrorism; organized crime; poor governance of states; energy security; territorial claims; ethnic and religious conflicts (Yugoslavia from 1991 to 1992, Ukraine in 2014). As globalization and regional integration is considered, these factors affect the security of state actors but also of the individual, providing at the same time new opportunities to which we have to adapt.

When analyzing these issues it should be taken into consideration the specific of the wider Black Sea region and the Western Balkans, with all the risks and specific security problems, influenced by the position of major state actors from the area who are directly affecting the situation of Romania, an EU member state and NATO on the border of these two intergovernmental organizations.

It is worth mentioning that these problems appeared and strongly developed after 1990, on the same time with the collapse of the USSR and the dissolution of the Warsaw Treaty, being present, even though aren't accepted by the world.

The fact Romania throughout it's leaders, actually chose to be a member of the most powerful collective security structures - NATO and EU, it is very important and guarantees to us, the citizens the preservation of fundamental national interests.

2. THE CONCEPT OF NATIONAL INTEREST, CATEGORIES AND FORMS OF MANIFESTATION

For a better understanding of national interest issue in the context of security and contemporary operational environment, we have to know very well the concept of national interest, the categories and forms of manifestation as a whole and also the factors that affect it directly.

The study of the national interests must be correlated with the analysis of fundamental values and national will and coordinated with the expression of the existing political authority at state level and with the conditions in which the political authority operates and develops the state actor. The geopolitical context, the state's level of power, including the available power tools are important for the analysis of the national interest concept.

Individual and collective perception is a defining element in the relationship of the elements mentioned before. It would be very well if these two types of perceptions are convergent and complementary, having the same finality of the national interests. By the process of perception are established variants of answer in response to various stimuli which have different scales reported to state or non-state actors. Reported to the level of development every nation has a different perception towards things that could affect the national interest.

Generally speaking, in the dictionary (DEX), the interest is explained as *"a concern on how to succeed in; a concern on how to obtain what is useful, pleasant, necessary, important, and it suits a situation; the effort made on an action to satisfy certain needs: advantage, benefit, gain, profit, having social importance and being helpful to the community. Active and sustainable orientation, intense desire of knowing and understanding someone or something. "*

The national interest is defined in different ways by individuals or institutions according to the perception of the surrounding realities:

- *"represents a numerous-normative system having a modeling and role-model role that expresses and promotes functional requirements of the nation, filters everyone's perception, determines attitudes and influences the participation at the national and international life, acting as a control function concerning the political interaction system"*.

In this case the definition involves a concept that relates permanently to the security environment. (Cobuz Constantin-Marcel, 1995);

- *"it is a customized form of interest from the perspective of a corporate life and work, coagulated into a form of political organization that is the national state"* (Buse Dorel, 2012);

- *"it reflects the identity of the people: its geography and culture, political preferences, social consensus, and the reached level of prosperity*" (PH Liotta);

-"the interest has a dual quality. It is an instrument of analysis for the researcher and the analyst of the international political phenomenon but also an action instrument for actors.

I used as an analytical instrument to describe, to explain and to evaluate the sources of a nation's foreign policy and its proper character.

As an instrument of political action, it serves as means of proposal, justification or condemnation of policies" (Rosenau James, 1994);

-"reflects the dominant, relatively constant and institutionalized perception regarding the national values. It aims to promote, protect and defend - by legitimate means - the Romanian nation values that guarantees its existence and identity, on which it builds the future and it is integrated into the European and Euro-Atlantic community and participates in the globalization process. With their range of expression, these are addressed - primarily – to Romanian citizens living in the national territory, and - equally – to all the other people living in Romania and Romanians living or working abroad." (*** Strategia de Securitate Națională a României, 2007)

National interests can be classified according to the importance and manner of implementation. More exactly the most important national interests are grouped into basic national interests which refers to respecting the sovereignty, the independence, the territorial integrity, etc. - elements which are not negotiable.

Then we are speaking about those which are regarding the negotiation in order to aplply it, such control agreements, and those which are negotiated permanently (eg. the using of airspace at peace).

USA classified the national interests into vital interests, crucial interests, very important, important and secondary (The Commission on America's National Interests, 1996).

National interests taxonomy classifies the groups in: economic, military, social, political, long-term interests, short-term interests and medium-term interests.

According to the National Defense Strategy, 2010 edition, national interests are represented by the existence of the state, its normal activity, its aspirations and essential needs to affirm the values and the national identity.

The fundamental national interests are the independence, the national character of the state, the sovereignty, the indivisibility and its unity.

It should be clearly that the defense of Romania's national interests becomes an obligation of every Romanian citizen.

Considering the definitions of national interest we conclude that this also includes the foreign policy.

The concept itself indicates the diplomacy's meaning which represents in the same time the state's foreign policy aspirations for which every country works for and which should be materialized in practical actions.

The national interests are those elements which animate the states actions reported to the international relations.

An interest becomes a national interest if it performs a significant percentage of the following indicators: the degree of generality (covering some problematic groups), the degree of sustainability, the possibility of appliance in political practice.

The national interests pursue ensuring the security and maintaining the welfare of the debated subjects.

The reality is that, the national interest is based on national values represented in practice by quantifiable objectives, having internal and external applicability through means and practical procedures.

To realize the national interests it's necessary to achieve the established objectives and to respect the national values.

The objectives, the values and the national interests are essential to establish and implement the National Defense Strategy, National Security Strategy and foreign policy in international relationships where Romania is a member.

The enduring nature of national interests is undoubtedly, the interests are described in the Romanian Constitution. Being an EU and NATO member, Romania accepts the same values as the other members in the allied context.

To highlight and defense the national values and interests, Romania complies with international treaties, with the principles of international law and cooperates with all international organizations involved in ensuring regional and global peace and security.

Mr. Cobuz Constantin-Marcel believes that the national interest has the following features: "relative realism; the transparency, achievable by publically following and direct participation of the interested citizens; horizontal and vertical heterogeneity explained by intrinsic values of national interest; mobile dependence as a result of random dynamic international environment, values dynamics, hierarchy of components dynamics and the degree of perennial; functionalism". (Cobuz Constantin-Marcel, 1995: 45-63)

In conclusion, the Romanian State, member of the Euro-Atlantic community preserves and promotes its national interests through various ways including maintaining and affirming the rule of law, defense of democracy, the way of creating favorable conditions for the free expression of citizens' rights, the act of respecting the human rights and ensuring the safety of the individual, the development of national economy in community context so as to be able to reduce the disparities that exist reported to the European states, the active participation in security and defense policy, supporting the national identity, the full integration into the European and Euro-Atlantic structures.

The economic development should be achieved by attracting foreign capital and foreign investment in their participation in the European common market and having „the four freedoms of movement", the application of tax cuts, a sustainable economic development on the principles of competitiveness, the active relationship with non-state actors (international organizations).

These goals are not viable without a constant and lasting involvement of the political factor and its instruments of power.

Regarding the fundamental interests (vital) of Romania consisting in a national defense and security costumed firstly by defending/ maintaining the sovereignty, the independence and the national integrity, followed by the protection of national identity in the new Euro-Atlantic area, things which are relatively clear and the Romanian state must address to the full integration in both NATO and EU structures.

The problem which remains unsolved in EU or in the federalization of Europe current case is that of state's total sovereignty , because now we are discussing about the disposing of part of it to the union.

3. THE RELATIONSHIP BETWEEN THE NATIONAL SECURITY AND DEFENCE INTERESTS AND THE COMMON EUROPEAN INTERESTS AND NATO ALLIANCE

Some of the fundamental national interests including national security and defense tend to gain more importance and make the transfer to the defense and collective security imposed by intergovernmental organizations, representatives of globalization.

The same seem to happen with financial problems or those related to the production made by multinational companies.

If regionally or globally the security is provided by oriented collective organizations

and institutions in the field of security and local internal conflicts, ethnic, religious or national, state although slightly weakened need to increase its duties.

Specifically Romania must solve the problem of national defense interests and national security through active actions by maintaing the unity and territorial integrity within its possession border reported to recognized international treaties, defending civilians from any attacks, participating responsible for all major collective actions, civil or military, organized and led by the EU or NATO.

Participation in joint military operations with similar items of the member states, involves national financial , logistical and human effort, proper equipment and therefore the application of recent NATO and EU, "smart defence", "pooling and sharing" and "connected forces", implies doctrines and procedures while adapting to the requirements of NATO and the EU, improving the C2, cooperation and useful information exchange, more exactly interoperability and standardization.

It's necessary to respect the commitment of NATO member states to provide 2% of PIB for national defense ministry, which will be reflected in equipment and training.

The manifestation of globalization by promoting collective security and defense system was specific to Romania after the Second World War as part of the Treaty of Warsaw, but also after the end of the Cold War when it opted to join NATO and the EU. Today, in 2014, when we celebrate 10 years since Romania's accession to NATO, 65 years after the signing of the North Atlantic Treaty and 20 years since the establishment of the NATO Partnership for Peace, we speak of fully integration into the Alliance and the EU, about the sharing of euro-atlantic values, and about the national and community interests.

To be a membership of these two intergovernmental organizations represents the full success of Romanian foreign policy during the transition to parliamentary democracy after 1990. This provides full guarantee of security to Romania in a historical stage full of unpredictable and asymmetrical threats in a complex where things are not stable in terms of security environment (eastern European area and the wider Black Sea region). Political dialogue focused on specific region issues including security and defense are the basics for the new security situation and challenges.

Romania is not just a consumer of security; it actively participates in NATO and EU operations, civilian or military, having capabilities to success in multinational operations, which is a real security provider.

The principle of cooperative security is applied by our country having a real success, developing complementary initiatives in Eastern European space. Generally, Romania's interests belong to Alliance and the European community.

The national security interests ensure the protection, prosperity and security of Romanian citizens in conjunction with the stability and continuity of the state as a whole.

The European Union is an intergovernmental organization founded on the common interest of the Member States that joined the common values. Union is based on the following values: *"respect for human dignity, freedom, democracy, equality, the rule of law and respect for human rights, including the rights of persons who belong to minorities. These values are common for the member states in a society where pluralism, non-discrimination, tolerance, justice, solidarity and equality between women and men"* (*** The second Article of the Treaty regarding the European Union).

The Union aims to the welfare of the member states promoting the common values listed before, acting only based on its competences for achieving the objectives presented in the treaty.

EU values and human interests are protected through appropriate policies that form the space of justice, freedom and security, promoted by the existence of the EU Pillar 3 as TUE, in conjunction with the free movement of population, goods, capital. Common interests and common will of the founder member states to carry out together are the elements which are the basics of the union formation and activity.

Some of the common interests of the member states targeted by the establishment and functioning of the EU are considered to be the strengthening of national economies, the convergent development necessary to increase the production, improving economic and monetary union by maintaining a stable and unique coin.

Therefore we can speak about true directions of development: economic, political, social, environmental, psychosocial and military.

From the point of view of the common defense and security, it is intended to amplify the PCSA which could generate a common defense, if the heads of state and government vote this, strengthening the power and position of Europe in a globalized world.

Most states of the EU are also members of the NATO, therefore the collective defense and security problem have to be studied and watched through the principles and complementary actions of the two organizations.

One can talk about a true Euro-Atlantic security community with complex institutions able to cover a wide range of issues of mutual interest. EU - NATO cooperation in security and defense developed while in the circumstances of challenges and threats that affected equally the organizations and the member states themselves. In this context, there have developed a true economic partnership between the United States and Europe, supporting the implementation of national economic interests.

The values and common interests of NATO states are the same with those of the EU which are: the rule of law, democracy, welfare, freedom, market economy, solidarity, individual freedoms, peace and stability in the regional and global common heritage.

Lately the US-Europe or NATO-EU relations are marked by: the interests of the USA to Asia-Pacific region (Dale Catherine, Towell Pat, 2013), the economic reforms and political support for the states in North Africa and the Middle East including a partnership to strengthen the security in the region (***Department of Defense, 2012), the affirmation of the powers emerging in this area mainly China and India, the NATO's interest especially for Article 5-crisis resolution type, the increasing of the military and political power while Russian interests are redirecting in its neighborhood (the case of Georgia, Ukraine, Moldova). In these circumstances the EU should assume a more important role for its own security and defense, primarily through the reviewing of the financial support of PCSA and NATO's contribution to security in Europe's neighborhood, the reviewing of the foreign policy towards Russia in the Ukrainian crisis conditions and the gas crisis that will manifest more interest within the winter of 2014-2015, the reviewing of different types of military and civilian operations that they can organize and conduct (Article 5 with NATO or the independently crisis management) in the near or distant area of interest, the ways how they can get involved in the Asia-Pacific in cooperation with the USA etc.

4. CONCLUSIONS

In conclusion, we can say that the national interest will continue to be represented and promoted by the state, but a remodeled state actor and adapted to the requirements of living in larger communities. The values, objectives and national interests will not be diminished in importance in globalization, but their practical implementation will differ methodologically.

The basics on which the national interests are built regardless their type are considered by some experts the sustainable economic development, the growth and the ensuring of the national security, the promotion of democratic values and good governance, the retrieval of coherence identity and social cohesion.

In the current security environment and the complex system of international relations that is created between state and supranational entities, the relationship between national interest and community interest (supranational) is one of determination from simple to complex, meaning the fact that the state actor and its interest in the prosperity and security, from a clearly defined political point of view, led to the formation of political and military organizations that must meet the hopes of those who created them (the national interests are priority compared with the community ones). Having an equity interest, meaning the power from the relationship between other actors, the state is determinate to take measures to strengthen the position of the bodies created. The interests of persons belonging to national and sovereign states should never be omitted.

The interests of member states expressed by their values and objectives must be realized through concrete ways at supranational level. At the same time, with the development of the new community organizations institutions and implementation of their policies, new community interests appear that the member states must recognize them as their own values.

The international organization promotes its own interests within initiatives launched by various member states which have to be discussed and adapted to the union so that it can represent the common interest.

The member needs animates the organization and action of the military-political organizations and their implementation contributes to the full structural integration.

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BIBLIOGRAPHY

1. Buşe Dorel, (2012). *Geopolitică şi Geostrategie*, Editura UNAp, Bucureşti;
2. Cobuz Constantin-Marcel, (1995). *Interesul Național – considerații de ordin conceptual*, in the study *Interesul național şi politica de securitate*, Institutul român de studii internaționale, Tiparul R.A. Monitorul Oficial, Bucureşti;
3. Dale Catherine, Towell Pat, (2013). *In Brief: Assessing the January 2012 Defense Strategic Guidance (DSG)*, US Congressional Research Service 7-5700, www.crs.gov. R42146;
4. Department of Defense, (2012). *Sustaining U.S. Global Leadership: Priorities for 21st Century Defense*, available at http://www.defense.gov/ news/Defense _Strategic_ Guidance.pdf, hereinafter "DSG";
5. Dicționarul Explicativ al Limbii Române;
6. Rosenau, James N., (1994) *Turbulența în politica mondială.; O teorie a schimbării şi continuității*, Editura Academiei Române;
7. The Commission on America's National Interests, (1996). *America's National Interests*, Centre for Science and International Affairs, USA, http:// belfercenter.ksg.harvard.edu/files/americas_interests.pdf;
8. *** (2003). European Security Strategy, Bruxelles;

9. *** (2010). Jurnalul Oficial al UE, nr.C83, *„Versiunea consolidată a Tratatului privind Uniunea Europeană şi a Tratatului privind funcţionarea Uniunii Europene”*, Oficiul pentru Publicații al Uniunii Europene, Luxemburg;
10. *** (2010). Jurnalul Oficial al UE, nr.C 115, „*Programul de la Stockholm – O Europă deschisă şi sigură în serviciul cetăţenilor şi pentru protecţia acestora”*, program UE în domeniul Justiției şi al Afacerilor Interne pentru perioada 2010-2014, Oficiul pentru Publicații al Uniunii Europene, Luxemburg;
11. *** (2007). Strategia de Securitate Națională a României;
12. *** (2010). Strategiei de Apărare Națională;
13. *** (2010). Strategic Concept For the Defence and Security of The Members of the North Atlantic Treaty Organisation, *Active Engagement, Modern Defence*, adopted by Heads of State and Government at the NATO Summit in Lisbon;
14. *** (1949). Tratatul Atlanticului de Nord, published on Monitorul Oficial, Partea I nr. 185 din 03.03.2004, appeared in România la 03.03.2004;
15. *** (1993). Tratatul privind Uniunea Europeană;

ELECTRONIC WARFARE IN INFORMATION AGE

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Abstract: *In this paper the importance of electronic warfare is presented taking into consideration the information age environment. In order to understand the electronic warfare this in information age, first we should understand what information age is and how the electromagnetic spectrum is used today. The Information age has changed every aspect of our life. For the first time in history we can create, access and store a high amount of information and all this happen during our life span. How has the military field been affected by all these changes? The military answer to the information age was the network centric warfare (NCW). As we can see, this concept NCW is affecting every aspect of the military field creating the evolution path from platform-centric to network-centric forces. When all military tools are physically limited in order to achieve military superiority we should exploit the new domain the information domain. Without this transformation it is not possible to achieve victory.*

Key worlds: *Electronic warfare, information age, network centric warfare*

1. INTRODUCTION

Electronic warfare is defined as the military action involving the use of electromagnetic and directed energy to control the electromagnetic spectrum or to attack the enemy (JP 3-13.1).

In order to understand the electronic warfare in the information age, first we should understand what information age is and how the electromagnetic spectrum is used today.

First let us go back in history when all these things started. The information age follows the industrial age and the question is what happened.

The information age is deeply rooted in the industrial age, when James Clerk Maxwell (1831-1879) proved theoretically the existence of the electromagnetic field.

In 1865, he published his work "A dynamical theory of the electromagnetic field" where he demonstrated that the electric field creates magnetic field and the magnetic field creates electric field and both travel in space in form of waves, at the speed of light. He told us that we are surrounded by an electromagnetic spectrum.

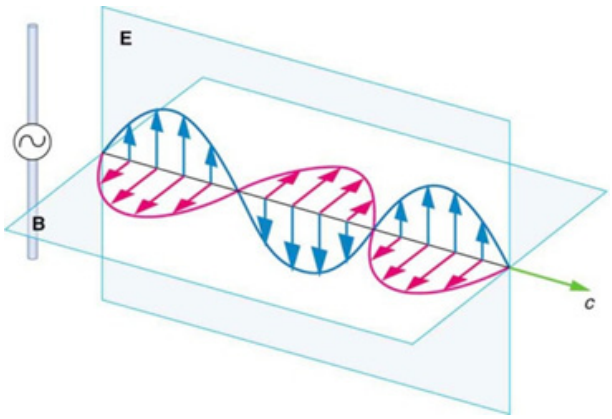

Fig. 1 Electromagnetic waves

The next big step was taken by Heinrich Rudolf Hertz (1857-1894) who practically demonstrated the existence of the electromagnetic waves. This research gave us the possibility to communicate over very long distances. For the very first time in history, we were able to communicate over long distances at the speed of light. But this big step was not enough to change the industrial age into another age.

Let us find out what happened in the military field in this period. We started to increase the use of the electromagnetic spectrum and to share it, with civilian application.

Now this process is still ongoing and in the future we will depend more and more on the electromagnetic spectrum.

During this time weapons had reached their physical limits and the speed of evolution decreased. In order to prove this I will give you a few examples. Let us talk about aviation. In order to achieve aerial superiority we have started to push the physical limits of airplanes. First, aircraft were developed to fly at higher altitudes. One example is the U2 Dragon Lady aircraft.

Fig. 2 U2 Dragon Lady Aircraft

This approach was not enough for the military demands. The design was fragile and could be shot down by surface to air missiles.

Secondly, it was developed an aircraft designed for high speed like Lockheed SR 71 Blackbird. Even this approach was not enough for the military demands. The aircraft achieved high speeds at high costs.

Fig. 3 Lockheed SR 71 Blackbird

The third step was the airplane Lockheed F117 Nighthawk which was designed to be less detectable by radars. This direction is under development but it is not enough to achieve aerial superiority.

As we can see, all the directions of development involved higher energy consumption and one design could solve only one problem, but leaving many others unsolved.

Fig. 4 Lockheed F117 Nighthawk

At this point through the history, in the middle of the 20th century something very important happened. The digital revolution started.

What's more the speed of evolution was grew exponentially. According to Gordon Moore's observation, the number of transistors doubles every two years. And the Moore law is applied in every digital domain.

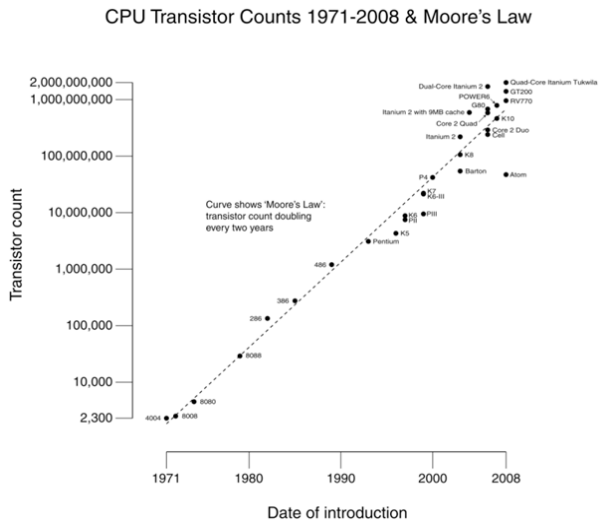

Fig. 5 Moore law

Now we move from industrial age to information age.

Practically now we can transmit a great amount of information over long distances virtually at the speed of light.

2. INFORMATION AGE

The Information age has changed every aspect of our life. For the first time in history, we can create, access and store a high amount of information and all this happens during our life span. How has the military field been affected by all these changes? The military answer to the information age was the network centric warfare.

According to Alberts et al. the definition of NCW is:

Network centric warfare is the best term developed to date to describe the way we will organize and fight in the information age. ... We define NCW as an information superiority-enabled concept of operations that generates increased combat power by networking sensors, decision makers, and shooters to achieve shared awareness, increased speed of command, higher tempo of operations, greater lethality, increased survivability, and a degree of self-synchronization. In essence, NCW translates information superiority into combat power by effectively linking knowledgeable entities in the battlespace.

As we can see, this concept - NCW - is affecting every aspect of the military field creating the evolution path from platform-centric to network-centric forces.

Also, we have changed our way of thinking from keeping the information to sharing the information. This approach requires a new type of commanders and a new type of military organization structure.

When all military tools become physically limited in achieving military superiority, we should exploit the new domain: the information domain.

Without this transformation, it is not possible to achieve victory.

A good definition of information superiority is: *"the operational advantage gained by the ability to generate and disseminate an uninterrupted flow of information while denying an adversary's ability to do the same"*. (FM 1-02)

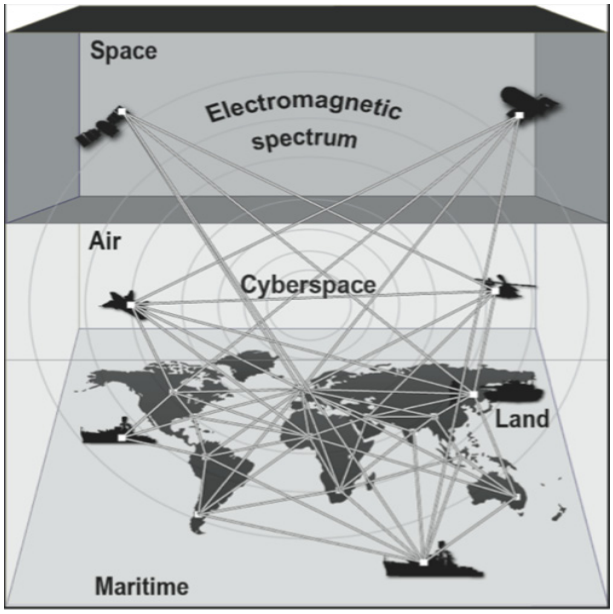

Fig. 6 Network centric warfare

From the electronic warfare point of view, the network should be created by using the electromagnetic waves connections because of the mobility of systems.

From my point of view, it is very hard if not impossible to cut all connections in a large network. The network will survive an electronic attack. It is important to protect the information in this network but this task does not relate to electronic warfare job.

The electronic warfare actions are in physical domain because the electromagnetic spectrum is very physical. The information transported by the electromagnetic waves should be protected by cybersecurity measures.

The real job of electronic warfare is to act on sensors which use the electromagnetic spectrum. The sensors can be any kind of systems, radars, communication systems, optical which work in the physical domain of the electromagnetic spectrum.

So, if the electronic warfare is not able to cut the network connections, because we will always find a path to communicate, the electronic warfare can reduce our capabilities to acquire information about the enemy at a tactical level.

Because the shooters are small and very mobile units, we must collect information about their position via the electromagnetic sensors.

Here, the electronic warfare actions are very important because without good information the whole concept of network centric warfare fails to work.

Because all sensors are networked, I will use the same approach like in a computer network. In order to protect a network it is not enough to install an antivirus software on every computer from a network.

The security measures must be applied to the entire network and the end user computer should be the last line of defense. In our case, the sensors are the end users in our network.

The sensors should be built to resist to electronic attack but this is not enough.

We should also have offensive systems not only defensive measures. This way, the electromagnetic spectrum in an area controlled by our forces can by efficiently used.

The things are simply like that: If you do not control the electromagnetic spectrum, you will be defeated; if you do not have air supremacy, you will be defeated; if you do not have boots on the ground, you do not control that area.

CONCLUSIONS

The real task of the electronic warfare in the information age is to attack and protect sensors. The sensors are our eyes and ears and if we cannot "see" and "hear" the battlefield, we will be defeated.

Today, but also in the future, the sensors will depend more and more on the electromagnetic spectrum. If our ability to acquire and to send information is reduced by the enemy, our concept of information superiority is doomed.

From this point of view, today and in the future, the electronic warfare role will be very important. For this reason, the physical domain of the electromagnetic spectrum should be at the same level as the land, maritime, air and space domains and all should be networked.

BIBLIOGRAPHY

1. FM 1-02, Operational Terms and Graphics, Headquarters, Department of the Army, Washington, D.C., September 2004.
2. D. S. Alberts, Network Centric Warfare: Developing and Leveraging Information Superiority, CCRP publication series, 2000.
3. D. S. Alberts, J. J. Garstka, R. E. Hayes si D. A. Signori, Understanding Information Age Warfare, CCRP publication series, 2001.
4. D. S. Alberts, Power to the Edge: Command... Control...in the Information Age, CCRP publication series, 2005.
5. D. S. Alberts, R. K. Huber si J. Moffat, NATO NEC C2 maturity model, CCRP publication series, 2010.
6. D. Adamy, EW 101: a first course in electronic warfare, Artech House Inc., 2001.
7. D. Adamy, EW 102: a second course in electronic warfare, Horizon House Publications Inc., 2004.
8. D. Adamy, EW 103: tactical battlefield communications electronic warfare, Artech House Inc., 2009.
9. L. Gherman, „Warfare in the Information Age," *Journal of Defense Resources Management,* nr. 1, 2010.
10. L. Gherman, „The Second Revolution in Military Affairs," *Journal of Defence Resources Management,* nr. 1, 2011.
11. L. Gherman, „Information Age view of the OODA loop," *Review of the Air Force Academy,* nr. 1, 2013.
12. D. Maccuish, „Orientation: key to the OODA loop – the culture factor," *Journal of Defense Resources Management,* nr. 2, 2012.
13. E. A. Smith, „Network Centric Warfare: Where's the beef?," *Naval War College Review,* 2000.
14. S. Topor, Război informational, suport de curs, Bucureşti: Editura U.N.Ap., 2004.
15. I. C. Vizitiu, Război electronic. Noțiuni fundamentale, Bucureşti: Editura A.T.M., 2005.
16. I. C. Vizitiu, Război electronic. Aspecte moderne, Bucureşti: Editura A.T.M., 2008.
17. I. C. Vizitiu, Război electronic. Teorie şi aplicații, Bucureşti: Editura A.T.M., 2011.

AEROSPACE POWER, A CHALLENGE OF THE NEW MILLENNIUM

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Abstract: *Ensuring the security and stability for the spatial dimension represents priority number one to the great economic and military powers of the world, with effects that can have a direct and negative impact on the environment and international security. For the use with responsibility and in peacefully conditions of this new dimension and in order not to expose ourselves to certain dangers and threats that may spread from space we need diplomacy and cooperation between nations, we need strong economic vectors enabling for the implementation of capabilities and cutting-edge technology, we need a new power.* ***Aerospace power****, critical to strategic decisions, decisive in the armed confrontations and pervasive in everything that stands for communications, command and control on the battlefield. This paper highlights the new challenge occurring with the discovery of the spatial dimension, space power, with missions, operations and technologies they use. It is that category of forces acting in a new battlefield, which, through the conquest of domination and control in the area of enforcement action, creates real advantages in conducting military operations on land, sea and air.*

Keywords: *space, satellite, rocket power, security, orbits, space programs, missions, crew.*

1. INTRODUCTION

The threats, dangers and vulnerabilities to which we are exposed and increasingly diverse and unusual areas in which they propagate, directly influence us and produce a variety of effects on the climate of security.

Outer space is one of the most complex and unpredictable dimensions from action can be taken (especially in military terms), for the creation of a State of insecurity, reason which is why the space security becomes a necessity for military, political, economic and social systems that affect both national security and international security environment.

The Concept of aerospace power, as it was defined by Philip Towle comes down to "use or prohibition of the use of airspace or alien for military purposes by the vehicles capable of controlled and sustained flight beyond the immediate conflict zone" [1].

The authors of the specialty regulations, and also some Americans researchers in the field, define the power of the air and space, "or just space ", as "the ability to use a platform or platforms operating in, or passing through, the air and space for military purposes" [2].

Regardless of how the concept of aerospace power is defined, it deepens the vertical dimension of the armed conflict on a three-dimensional perspective that allows component forces to act when and where necessary, without the geographical and physical limitations imposed on other categories and types of forces. Thus, the future armed conflicts will concentrate on the vertical component, while the surface components will become forces of support for military action in space. This kind of war will not have contact alignments; it will be a military confrontation without a front line.

Changing the face of the war has generated new dimensions and new configurations for modern military conflicts, these being "walked through the extensive use of smart weapons will destroy precisely localized targets with low losses, the enemy is defeated in terms of military and political, in most cases without his Eyrie" [3].

2. MISSIONS AND CHARACTERISTICS OF AEROSPACE POWER

Concerns related to aerospace power focused on the use of cosmic installations for military purposes and, they began in 1953,

before the launch of the first satellite, Sputnik, when the United States Army Air Forces hired, the company RAND (**R**esearch **AN**d **D**evelopment - the company was formed to provide the results of its research to the U.S. Armed Forces), to conduct research and analysis of military applications that can be deployed from satellites.

The results were soon to appear, they highlighted the military actions of spatial installations (satellites), such as: photo recognition, navigation and communications, remote sensing and meteorological research.

In parallel, the USSR started, in 1962, the launchings of the Zenit satellites, from the recognition satellites class. Improved models released later are equipped with optical systems performance, and the program developed by the Soviets includes sending in space of the first autonomous module, " Nauka", intended to carry out experiments with gamma rays, high energy protons that develop energies greater than 100 Mega-electron volts and electrons with energies larger than 20 Mega-electron volts.

Later, on "Nauka" modules there were installed infrared telescopes and microwave systems, all of which were destined to the study of radiation on Earth, especially those areas from the Polar Regions, below the ice caps.

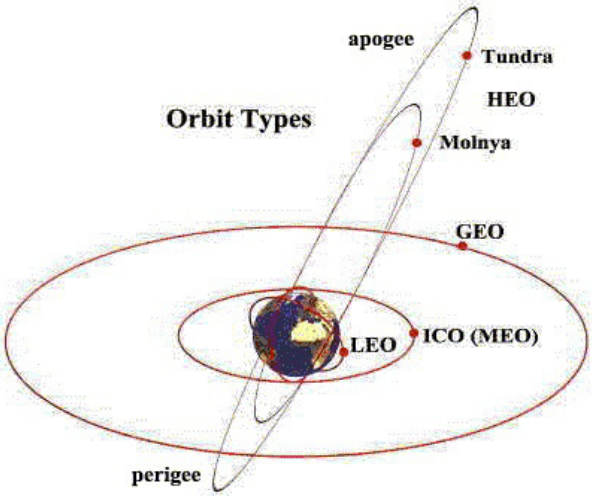

Fig.1 Orbits that currently have military satellites [6]

The main missions of aerospace power, developed by military satellites on their orbits are:

- photographic reconnaissance missions generally carried out by LEO low orbit satellites (elevation 80-2000 km);
- navigation, missions carried out by MEO medium orbit satellites (altitude 2000-35000 km);
- electronic research missions performed by satellites placed on GEO geostationary orbit (altitude around 35000 km);
- communications, missions carried out by satellites that use the elliptical orbits of HEO (apogee of more than 35,000 miles and perigee around 1000 km).

With the first results obtained by the use of satellites for the recognition, the problem of counteracting their actions was raised, and the first step in protecting the objectives was the development of means of detection and tracking of satellites.

Thus arose the first operational system of satellite tracking, Minitrack system, built by the U.S. in 1957, in the same period in which, the USSR launched Sputnik-1.

The system was designed for both the detection of Sputnik satellites, as well as for keeping track of their own satellites, Explorer and Vanguard.

Subsequently, such systems have improved and developed using constellations of satellites and they diversified in terms of belonging to the structures and use of surveillance/ reconnaissance systems, enhancing its monitoring networks.

Currently, strategic changes and emergence of destabilizing situations led to the extension of these networks for surveillance space to the Space Surveillance Network (SSN), founded by the USA Network, which operates on the basis of 31 locations around the world, equipped with optical sensors and cameras that have a dedicated satellite.

In parallel, the space surveillance systems developed by Russia, called Okno and Krona, operates in 14 locations, with over 20 cutting-edge optical instruments, imaging radar and a high powered telescope that can be adjusted to provide weather data from Russia, the most accurate, as well as the ability to obtain high resolution images from satellites

Thus, out of the carousel of changes and innovations experimented by spatial military actions, some features stand out, whose importance will grow in the future, offering space power, the dominant role of strategic power.

Application of the concept "high-tech" and the use of the latest technology advancements in the field is a premium feature of military space operations. For example, a new generation of satellites with optical hard detectable radar has already appeared, under the code name "Misty".

They evolve with an inflatable balloon, whose wrapper is reinforced under the action of UV rays and which has also been designed to reflect electromagnetic radiation and to reduce the footprint in the visible spectrum.

Another important feature of the military space operations is given by the decisive effect on the character of the joint military action obtained by joining of components by land, air and naval forces.

This feature requires the ability to organize joint actions on tactical field, based on the information received from the surveillance/reconnaissance systems, achieving interoperability between elements of the forces categories, by using identification data and by establishing positioning with precision through spatial networks that monitor the battlefield.

The execution of the decisive hit, the fire, is a characteristic of spatial, decisive military action. Vectors used to transport fire to target are placed on spatial systems that allow simultaneous slamming of several targets of the strategic adversary, regardless of the degree of their dispersion and geolocation.

Technologies used allow data collection and processing the information, while near-real, providing in-depth knowledge of the space battle and creating ideal conditions for timely intervention in the opponent's device, where it coagulates centers of gravity.

All these characteristics of space-based military action create the ideal conditions for achieving absolute supremacy on the battlefield, wherever they are, and offer the possibility of military action in terms of less favorable physical forces, making invisible the relationship between offensive and defensive and in accelerated paces, with immediate finality.

3. SPATIAL TECHNOLOGIES

The exponential evolution of science and new discoveries in the fields of engineering and technology have created a technological revolution with a direct impact on human society and with major effects in the military, leading to changes in military strategy and tactics.

Once the gate to outer space is open, the newest inventions of the engineering and technology are applied to space vehicles.

The launch of the first satellite, Sputnik 1, on October 4, 1957, and its evolution on orbit around the Earth, for several months, was the beginning.

Some of the general characteristics of Sputnik 1 are:

- a sphere made of aluminum, with a diameter of 58 cm.;
- 83.6 kg weight;
- equipped with four antennas;
- Silver-zinc batteries;
- radio transmitter power: 1 W;
- pressure and temperature sensors;
- made up of two shields, one serving for thermal protection, the other being pressurized.

Its mission was to check out pressure and thermal throttling, principles for this, inside, the satellite there was a quantity of nitrogen, maintained at a slightly higher pressure than the atmospheric pressure of Earth (1.3 atmospheres) and a fan for cooling the equipment.

On the other side of the globe, the United States started the space exploration by launching, in 1956, the first world's military space program "117L" Weapon System (WS-117L). That program evolved and materialized through the arrangement of the orbit of a satellite constellations for photographic reconnaissance, "Corona" type (fig. 3) [7], KH-1, KH-2, KH-3, KH-4, KH-4A andKH-4B.

Fig. 2 SPUTNIK – 1 Satellite

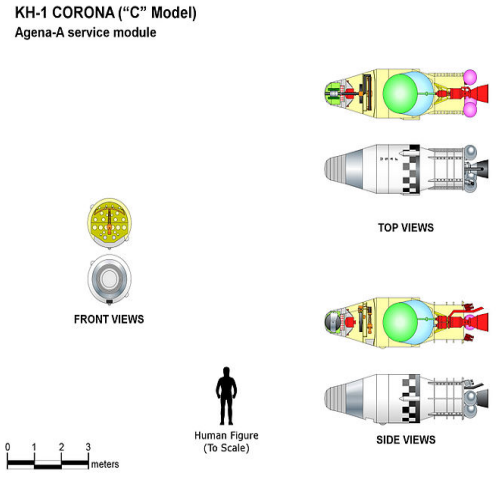

Fig. 3 Corona KH – 1 Satellite

The operating program of strategic research satellites "Corona" was subordinated in the period 1958-1969 to the Department of science and technology of the CIA (Central Intelligence Agency), which benefited from the support of experts and missile launch bases belonging to the U.S. Air Force.

Thus, in the first instance it succeeded to take photos of the strategic objectives within the territory of China, the Soviet Union and other communist States, and at the end of its mission, the CIA launched 22 satellites on orbit, under the code-named KH, short for "Key Hole".

Important is the fact that 9 of them (models KH-4A and KH-4B), were placed on a high orbit and were equipped with ELINT equipment [8].

The second phase of the space program "Corona" corresponded to the placement on different orbits of satellites from Discoverer class.

The last mission was a great success when the capsule of Discoverer-38, released on 26 February, 1962, was recovered in its entirety, and the information collected could be used by the CIA.

Feeling threatened by developments in the field of American space programs, the USSR starts the production of medium-range ballistic missile and intermediate action, which obliges US to build a defensive system of early warning of the attacks of the polar regions of the northern hemisphere, BMEWS (the Ballistic Missile Early Warning System). Having received the consent of the Governments of Canada and Denmark (under which lies the Greenland tutelage), US builds a chain of radar stations designed for the detection and tracking of ballistic missiles.

In parallel, the US develops as part of program WS-117L, a sub-program, "G-System", intended for the production and use of infrared sensors on satellites, which will refer the matter, from orbit, the launch of any ballistic missiles.

The sensors were manufactured by ARPA (Advanced Research Projects Agency), an agency subordinated to the Pentagon, and shedding satellites, MIDAS (Missile Defense Alarm System), had owned the conjugated system alerting distant radars, BMEWS.

The Soviet approach, in terms of the development of spatial capabilities was different from that of the U.S.

While Americans developed technology, Russians preferred to alter and to adapt the technology that was already in use, using the systems tested in the early stages of the space program, managing to lower the cost and reduce the time required for development and construction.

Priority of the Soviet space programs focused on the development of the research on the use of permanent human presence in space and the implementation of plans that would allow human activity on future space stations.

Thus, since 1971, the Soviet Union developed the first program to build a space station placed in low orbit of the Earth, space station “Saliut”, which commenced from the program of secret military space station, “Almaz“.

In addition to the military teams, on the space station and were teams of researchers who studied the effects of living in space for long on the human body. Saliut is the first space station in history which has been inhabited by people, they succeeding the first modular space station "Mir", in 1986.

The basis of this level and addressing progressive directions in terms of operations and the use of outer space, space activities are carried out in the form of programs, are becoming the preserve of all States and benefits from the latest technological inventions, engineering and those in IT [9].

The U.S. Space Agency develops through NASA, a series of space missions and programs, of which the most important are:

-Mercury Program-1958-1963 with six manned flights;

-Gemini-1962-1966 with twelve flights ten of them manned;

-Apollo Programs from 1 to 17, conducted during the period from 1967 to 1972, with eleven manned flights and six moon landing of monthly modules, of which the most important, the Apollo 11 mission, when the first manned arrives on the Moon's surface;

-Since 1983, was modeled on the US-Russian Mir Space Station project, much more complex, with multiple bins and modules to fit out the labs, berthing compartments, crew compartments, storage spaces.

The high costs of production and installation on orbit make the Washington administration to invite other countries to participate in starting the project.

Thus, Space Station gets International Space Station (SSI), after accepting the: Russian space agencies - RKA Japanese space agencies - JAXA, Canadian space agencies -

CSA and ESA - European space agencies (an Association of several European countries) that together with NASA work to launch International Space Station project. Currently, 16 Nations participating in this project, 11 of them are from Europe.

In parallel with the ISS, United States and Russia both focuses on programs such as STS (Space Transportation System) like "Space Shuttle", respectively on the "Buran", (fig.4) [10], programs that including missions to launch satellites and space probes, transport people into space, carrying supplies for the international space station, another mission of maintenance and repairs for spatial systems already in use.

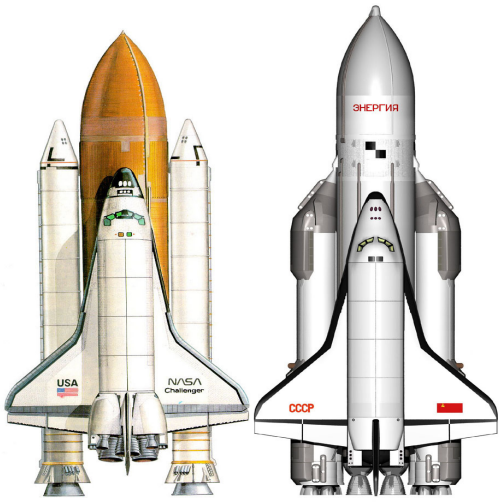

Fig. 4 Space vehicles Challenger (USA) and BTS-002 or OK-GLI (Soviet Union)

4. OPERATIONS AND MILITARY SPACE ACTIONS

Modern military actions have proven to be more effective when they had integrated into their operations and capabilities information provided by space-based systems.

Providing global communications, insurance with data about the position/navigation, creating possibilities for synchronization of actions, providing surveillance services/smart and recognition of the environmental monitoring, together with the development of the system for warning of combat forces, confirming the importance and need for space forces involvement in military operations.

Starting from the basic mission of any category of forces, namely to ensure the safety and security of our own nation, or that of the Alliance, the space forces and integrate them into military operations by ensuring the deployment of space-based missions, specific, such as:

- knowledge of the general situation and the spacecraft, while muddling permanent alertness;
- increase the effectiveness of space-based military forces through the processing and transmission of data and information;
- providing support to the forces supporting elements from space;
- ensuring the supervision of space;
- spatial forces intervention.

All these missions are designed to contribute to the integration of spatial forces in joint operations and increase the effectiveness of military operations.

Knowledge of the general situation and the space is fundamental in the direction of spatial operations. It involves the existence and use of General knowledge about the operational environment, in consonance with the processing and interpretation of data and information specific to each spatial operation in hand.

Knowledge of the general situation in detail and mastery to the smallest detail of the spatial situation depend to a large extent, on getting information about the enemy's capabilities and capacities, information provided by the sources of "intelligence" and which may reveal the intentions and actions of the upcoming opponent.

Increasing the effectiveness of space-based military forces operations is carried out by the processing and the transmission of data and information and represents a basic mission of the space forces, which determines the amplification efficiency of joint forces participating in military action, by increasing the potential for fighting strength by providing combat support for other joint forces, support.

To ensure this mission is due to information systems, surveillance and reconnaissance (ISR), the use of warning devices, missile tracking and interception, detection sensors of positions and of the moment of launching ballistic missiles, as well as the equipments of environmental monitoring and ensuring communications and satellite.

Providing support with support forces from outer space is another mission to space forces that includes essential capabilities, functions, activities and tasks required to support all forces, across the range of military operations.

It is achieved through the actions of implementation, support and organization of certain constellations of satellites, with clear,

predetermined missions, aiming at supporting military operations in order to ensure national and international security.

Checks from space provides for their own forces, freedom of action in space and, and when necessary, the development of military operations which lead to the Suppression of any of the actions or intentions of the adversary to attack in space or on Earth's surface, with systems that have the capabilities to evolve into space or in circum-terrestrial space.

Control of space and spatial operations is growing in two directions, depending on the character of military operations in space.

Thus, one can speak of spatial operations offensive, when you develop some actions intended to remove temporarily or definitively spatial systems capabilities of the adversary, or defensive, when it preserves a quiet space, when they held only passive action, designed to protect the space and taking place without representation possible, future threats or hazards to the safety and security of national and international.

5. CONCLUSIONS

Space forces intervention holds decisive influence over military operations and especially the armed confrontations, regardless of the conflict zone where it takes place. In addition, the discovery and delivery of data which can result in the removal of some targets, even at the strategic level, the surface of the Earth, the space forces can perform missions involving the management of weapons systems on the platforms space or in the depth of its territory to combat launches of intercontinental ballistic missiles of the enemy.

Therefore, the spatial power, through its military actions and operations, represents a very important vector, omnipresent and decisive for total security, with shares more than those of the other discharges during storm periods category forces, characterized by quickness, precision and maximum efficiency at target.

In the present paper there are presented, in chronological order, some of the programs, projects and concerns related to the safety of circum- terrestrial space as well as the reactions of the great powers, in front of threats that can come from the outer space.

The most important conclusion of the analysis is that it confirms once again that the future Aerospace Power will be part of the National Safety Systems of the countries of the world, and we have the space to deal with the space policy, space strategies, laws and norms that regulate the activity in space and why not even justice and policing space.

We must be prepared to scale the ladder of knowledge up to the top step, where it is necessary to provide a geospatial environment security, through an extension of security in space and the fourth dimension and an overall understanding of the new trends of conflictuality and war, in an era of Cybernetics and a society of knowledge particularly advanced.

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BIBLIOGRAPHY

[1]. Towle, P., „*The Dynamics of Air Power"*, Royal Air Force College Publishing, Bracknell, (1996).
[2]. Air Force Doctrine Center. *Air Force Doctrine Document (AFDD 1-2),* Air Force Glossary, (2007)
[3, 5]. Toffler, A., and H., „ *War and antiwar. Survival at the dawn of the 21st century*", Publishing Antet, Bucureşti (1995).
[4]. Gl. Mr. Rus I., Col. Cioabă A., „ *The vertical component of modern war*", Military Publishing House, Bucureşti, (1988).
[6]. Source. [online]. Available: http://www.tehnomil.net /2012/05/31/statie-romaneasca-de-detectie-si-urmarire-a- satelitilor
[7]. Source. [online]. Available: http://en.wikipedia.org/wiki/Corona_(satellite)
[8]. Source. [online]. Available: ELINT-Electronic Intelligence, https://www. nsa.gov/about/_files/cryptologic.pdf
[9]. Longley, D., Shain, M., „*Dictionary of Information Technology*", Publishing House. Macmillan Press, (1985).
[10]. Source. [online]. Available: www.buran.su/buranvssts-comparison.php

SYSTEMS DESIGNED FOR INTELLIGENCE PROCESSING AND COLLECTION SPECIFIC TO ORGANIZED CRIME FIELD

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Abstract*: Under the contemporaneous conditions caused by the set of illegal operations performed on large areas by criminal structures of network type, with great action capabilities and specific activity of collecting, analyzing and disseminating data and information used in decision making process, becomes a particularly important activity both at leadership and the execution levels of the integrated system security and national security. In this article we will detail all important aspects related to the collection and processing of information specific to cross-border organized crime.*

Key words: *security and national security, space of informational interest, business intelligence, transnational organized crime, gathering, processing and disseminating information.*

1. INTRODUCTION

The whole activity of collecting, processing and disseminating data and information in the informational area of interest is a matter for specialized informational units, hierarchically organized (tactical, operational, strategic, political-military, etc.) basing on a number of priority requirements or critical data and information set by the governing structures of hierarchical echelons.

The succession of stages in informational activities, particular for information sources, decision makers and beneficiaries form an informational cycle, involving every level, providing information superiority and the opportunity to conduct all types of operations (crisis response, risk management and asymmetric threats anti and counter terrorism, combating transnational organized crime, etc.).

Within the system of prevention and combating the phenomenon of transnational organized crime the collection and dissemination of relevant data and information in the area of interest can become very important due to the unexpected and subversive nature of criminal structure actions, quick shifts of as well to the hidden effects induced by them.

For these reasons, it is very important that the whole process of collecting and disseminating data and information, specific to combat cross-border organized crime, to rely on constant adaptability and flexibility against the threats and risks.

The efficiency of informational process will influence also the opportunity and effectiveness of specialized structures reacting, even before the crisis in area of responsibility.

However, in such asymmetrical cases, conventional indicators, which are targeting the specific way to collect and select of information, can sometimes be irrelevant due to the high degree of uncertainty of the measures and actions taken by potential adversaries, and therefore we should establish new indicators to render the necessary potential to prevent and combat terrorism and cross-border organized crime structures.

An approach of this type, involves a particular management structures, of safety and national security, a specialized and assiduous tactics and Staff training, from peacetime, at both national as well as in other areas, ally or coalition system, respecting the proper substantiation of efficiency criteria indecision making.

As a conclusion, it should be understood that the specific activity of collecting, processing and disseminating information regarding the situation in some areas of strategic interest should remain continuous, so that in crisis situations, specialized structures will receive timely information in order to act effectively.

The priorities of information needed to prevent and combat cross-border crime shall be established according to the needs and interests of ensuring national security and public order, the weight and nature of asymmetric threats and risks, on the characteristics and trends in the security environment of high vulnerability, on the position and attitude of internal and external actors, and the abundance of information resources available.

It should be noted that the priorities of intelligence is established in accordance with the activity / operation purpose, the nature and rank of threats and vulnerabilities that can be subjected for the security system, and it depends on the impact of collateral risks that could amplify crisis or unconventional threats .

To ensure an efficient management of the intelligence structures, another important condition is also the appropriate organization of data and information collection activities.

For this purpose is required detailed and clear description of the all involved structures responsibilities because any uncertainty or the existence of gray areas can cause serious malfunctions, structures overlapping, neglecting or declining tasks or skills.

The task to establish the area of responsibility for authorities belongs to the echelons of activity informational systems.

In this respect, coordination becomes an essential factor in the activity of management systems of cross-borders organized crime.

Focusing efforts is intended both to stimulate the employment of intelligence structures and to grow their expertise in gathering information from criminal organizations or groups too.

Threats against these structures, being asymmetric, requires a higher attention for their continuous tracking, both at the national and the transnational level, especially for structures with tasks in the field.

To elaborate management of the operational situation documents for the national territory, they shall include in particular information upon: policy, ideology, leadership, organization, structures and their area of location, operating methods, training bases, logistics, sponsors, endowment arms, sources of supply, bonds of cooperation and international relations, action plans, features, objectives targeted and their implications on safety and national security etc.

The activity of intelligence collection is a highly complex process. This is carried out by the sources of information which are looking, identifying and collecting data and information which are then subjected to a process of analysis, interpretation and integration within specialized departments.

Integrated national safety and security system has the following sources of information (***IPS-3, Doctrina pentru informații, contrainformații și securitate a armatei, 2005:20): official sources, human sources, technical sources and public sources.

The use of personnel in collecting data and information is performed related to the nature and character of network or organized crime groups' activity.

Without exception in all cases, should be used specialists trained to collect intelligence, regardless of practical work: HUMINT - human intelligence, IMINT - information obtained by analyzing images from different sensors; SIGINT - information obtained through the telecommunications and OSINT - information from open sources (internet, media, publications, etc.) (Stan Ioan Constantin, 2007:51). For success, it always requires the application of appropriate methods of choice for agents and how to cooperate with them.

Regardless of the means used and the practical ways of operating, the integrated safety and national security shall provide sources of information collection and selection of the specialized structures of SRI, SIE, DGIA and DGIPI.

The structures of the Romanian Intelligence Service (SRI): conducts technical and informational activities to combat and prevent organized crime; executes intervention missions against crime for destroying or preventing their attacks; participates in restoring the legal order; share information with other specialized structures, in accordance with rules established by CSAT.

The structures of the Foreign Intelligence Service (SIE) are conducting special missions in foreign intelligence related to national security and they are defending national interests; they use appropriate means and methods to obtain, check, evaluate, recover and store intelligence and data related to national security; they are running counter-intelligence specific activities or personnel or own protection in the country or abroad; they are controlling the entire operative, diplomatic courier, security, state code, financial assurance, technical and sanitary materials.

The structures of General Directorate of Intelligence and Internal Protection (DGIPI): are running specific tasks of purchasing, centralization, processing, dissemination, data and information protection related to the operational situation and assessment of risks and threats against the public safety and order; coordinates the gathering of intelligence about potential threats and asymmetric risks to the safety and public order, ensure dissemination of information to structures of integrated security and national security and in the National Intelligence Community; cooperates with other specialized structures from other institutions which participate in the exchange of information for the fight against transnational organized crime.

The Structures of General Directorate of Defense Intelligence (DGIA): are conducting specific tasks to ensure, establish, plan and target priorities on information requirements; provides collection, processing, analysis and dissemination of important information for the national defense and security; are running information centralization of activities related to the potential asymmetric risks and threats to the national security and defense; cooperate with other specialized structures of the institutions with responsibilities in the field, in order to achieve data exchanges of information needed to combat organized crime; ensure the transmission of information to the National Intelligence Community and to other subsystems of the integrated national security.

Basically, the special activities for collecting intelligence, by the structures with responsibilities in this area, comprises search-processes, identifying, obtaining and gathering information (***Doctrina națională a informațiilor pentru securitate, 2004:25) to prevent and combat domestic or cross-border organized crime.

Searching Intelligence on the phenomenon of organized crime is a process that establishes and directs specialized structures on areas of informative interest and the sources from where you can reap obtain, collect or produce information necessary for decision and action, and to prevent and combat cross-border activities.

Identifying the system of risks and asymmetric threats to national security, is a very complex activity, specific for informational structures, by which they are documented on the situation of potential opponent in the sense of knowledge, evaluation and control its actions, which may affect national security.

Collecting intelligence represents the activity conducted by structures in the purpose of sampling representative data and information for the domain addressed (in some open sources, studies, publications, etc.) and to establish the type of response necessary to counteract or prevent specific actions of organized crime cross-border structures.

Obtaining intelligence about criminal structures involves the use of methods and procedures to access data that may be accessible only by the use of specific means (most often under the authority of a document / warrant issued by a judicial authority. Situations of this kind require means and technical systems equipped with sensors to collect data and information (Frunzeti Teodor, coordonator, 2011: 717-719), ready just in border areas,

borders or back, noting that those sensors should be adequate to detection of information for purely operational interest.

The specific activity of search, identification, collection and obtaining information upon the criminal structures should provide a better understanding of the level of risk and asymmetric threats in the field of cross-border organized crime and own domestic vulnerabilities, dysfunctions and targeted objectives, the structure of criminal forces and directions of their action, the type of business and their character (nonviolent or violent) and their implications for national security.

It is very important to remember that the intelligence activity contains both organizational issues and problems of knowledge in different forms of potential adversaries. The question of potential opponent is the axiomatic element, regardless the type of action. This is where the conspiratorial character, subversive and elusive of all structures with criminal nature, aspects that highlight the important role of informational structures in combating the scourge of organized crime activity.

Intelligence processing is the activity through which all data collected from border areas of informational interest are processed and converted into information. For this there should be a database of integrated and national security, which accumulates information and continuously update them while measuring their processing.

Intelligence processing resulted from data obtained by sources may include the following activities: sorting, analysis, evaluation, interpretation and integration of data and information.

Sorting is a kind of administrative activity in which data can be taken out and then grouped into categories or types of risks and specific threats to areas of organized crime. It is important that, after this process, specialized structures to understand the level of addressability, reliability of information and the degree of networking within the information system.

Assessment is the appreciation activity of intelligence after their contents and reliability of the sources. From this point of view, can yield reliable information or a lower degree of reliability. At this stage of processing, information obtained shall be selected as follows: real and credible information (this can be further analyzed), probably true and credible information as possible; improbable and unreliable information that remain pending (they can be subject to further analysis with other data obtained through exchange of information with some specialized structures).

Intelligence analysis allows selecting items with significance in preventing and combating cross-border organized crime, which are correlated and combined with known emerging events, from which we can draw conclusions.

Intelligence integration is the specialists' specific mental process (center of gravity or the core of processing activities), which is facilitating both the accurate data interpretation and the selection of upper level which they can address. After integration, information and data can be interpreted to give valuable intelligence for the field and the appropriate response in action plan.

Intelligence examination can solve the following issues: clarifying the significance of information and data; anticipating the likely future trends and influences; conclusion if they amend or confirm the already known (especially if they show some increases risk), if it is necessary to supplement research sources and for how long.

In fact, you have to answer a few questions, so? Who did what and why? What consequences can derive from this? In what sense has acted? If everything is or not clear? This may be the final step in data analysis and the last real opportunity to forestall some attempts disinformation. However, it is necessary to put the following question too: interpretations and responses are fair or rather are those variants that criminal organizations gathered from us? From here, may result decision to request additional data or not.

At the end of the process all the raw data can be transformed into information that can be the fundamental key of knowledge objectives in informative process. In this respect, the ability *of prevision* can be one of the important conditions for the efficient conduction of actions to combat and prevent transnational organized crime phenomenon. All information resulting from the data processing activity will allow decision makers *to anticipate*, a strategic prevention of state authorities about any possibility of the occurrence of such transnational or national criminal actions or warning / alarm about the probability of asymmetric threats. Decision making of the state can estimate the type of preventive or preliminary action can be carried out to suppress criminal structures.

For the ongoing threat, structures and specialized services can move to annihilate the criminal structures right from the beginning. Considering that the phenomenon of transnational organized crime can occur with all forms (from illicit material trafficking to the illicit people trafficking, from smuggling to cyber attacks), becoming a global phenomenon particular to modern society, requires that the intelligence activity of specialized structures have a constant regard to these types of threats. Moreover, the activity of information should specify very quickly, the nature of potential and actual threats represented by the structure of criminal nature.

The proper estimation of threats is very important because is the key factor in a decision taken by the state authorities in connection with the dynamics of the measures taken. These measures should be included in a plan detailing the contingencies (emergency or crisis). If seriousness is overrated, efforts will be exaggerated, and the consequence will weaken the credibility of the concerned intelligence service; if gravity will be minimized, some measures taken are inadequate, the result being the same, weakening the credibility of the intelligence structures. Therefore, it is important to pay attention to ideology of criminal organizations with all their ramifications.

Only a thorough understanding of their motivations, the potential influence evolved and aggressive ways of action will have an active role in preventing and reducing the threat and dangers to international democratic world.

CONCLUSIONS

Democratic States must intensify specific measures to combat the scourge of organized crime expanded at a global scale. Plans should be drawn up based on the correct definition of asymmetric threats based on data and information available at the time. Resources should be assigned on the basis of realistic estimates and then be taken concrete measures both in training and in local and international cooperation. All this cannot be supportive if the authorities are not convinced of the existence of specific threats. The intelligence activity will face many difficulties, especially in the early stages of growth of asymmetric threats when it comes to issue of allocation of additional resources.

Dissemination of processed information involves opportune and undistorted transmission to all beneficiaries (***IPS-3, Doctrina pentru informații, contrainformații și securitate a armatei, 2005:31-32) of all information collected in the computer system, which will go through the normal chain of processing and evaluation, so that they can be distributed to beneficiaries quickly and in a usable form.

Only such intelligence activity could play a major role in fighting and preventing transnational organized crime.

Useful information must arrive accurately at the important decision structures and in the time required that can facilitate preventive action to disrupt planned actions of a potential opponent. In this respect, the use of alarms should be appreciated by all services of the military-political structures as a top priority and the staff directly involved must pay attention both to collection and information processing and to evaluate each specialized fragment of information that would indicate or suggest the possibility of an operation with criminal nature.

One can appreciate that the activity of information insurance of system for combating organized crime should be regularly evaluate in order to achieve the necessary feedback to increase the quality of decision act and effectiveness of response in action plans. Equally important is the focus of specialized teams from all structures, dealing the actual work of collecting data and information, especially of data with high degree of risk, their experience can turn the work done with passion in a true art.

BIBLIOGRAPHY:

1. *** (2004). *Doctrina națională a informațiilor pentru securitate,* Bucureşti;
2. *** (2005). IPS-3, *Doctrina pentru informații, contrainformații şi securitate a armatei,* Bucureşti;
3. Bălăceanu Ion, (coordonator) (2010). *Interactiunea sterategiilor în conflictele armate moderne*, Editura Universitătii Nationale de Apărare „Carol I", Bucuresti;
4. Frunzeti Teodor, (coordonator) (2011). *Lumea 2011 - Enciclopedie Politică şi Militară (Studii Strategice de Securitate)*, Editura CTEA, Bucureşti;
5. Frunzeti. Teodor (coordonator), (2013). *Lumea 2013, Enciclopedie politico-militară (Studii strategice si de securitate)*, Editura RAO, Bucuresti;
6. Grumaz Alexandru, (2013). *Al treilea război mondial,* Editura RAO, Bucuresti;
7. Stan Ioan Constantin, (2007). *Comanda şi controlul structurilor de informații la nivel operativ,* Editura Universității Naționale de Apărare „Carol I", Bucureşti;

THE VACUUM-PROPULSION TECHNOLOGY- CONCEPT AND APPLICATIONS

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Abstract: *most aircraft made in the XXth and XXIst Century are based on achieving the buoyancy on special surfaces ("bearing surfaces") and the physical principle applied (in connection with the Bernoulli's law regarding the flowing of fluids) correlates the bearing force with the profile and the active bearing surface, also with the fluid characteristics, including its velocity. The result was that the low pressure which can be obtained at the extrados of the bearing surface, gives the amount of the lift force. Therefore, the attention of researchers was directed toward the possibility of obtaining very low pressure on the extrados, possibly even the vacuum. Thus it came to vacuum propulsion technology presented in this paper*

Key words: *VTOL / UAV / Unconventional*

1. A BRIEF HISTORY

To make easy the flight and even to make the individual flying apparatus for humans, were ancient desires of the people, starting from the mythological Icarus, and reaching the works of Leonardo da Vinci, who studied the art of flight at birds and bats. Later in the XIXth Century, it reborn the interest in creating an aircraft and a number of inventors have tried to find the necessary technological solutions.

Between them, a few even managed to obtain very interesting results:

- *Karl Wilhelm Otto Lilienthal* (b. May 23, 1848 in Anklam, Germany - d. Aug. 10, 1896 Berlin, after an accident with one of his flying machines) was an aviation pioneer. It is believed, that he was the first man who built and flew an aircraft heavier than air, by launching it down the slope. His experiments helped to establish later some of the laws of aerodynamics. However, it is questionable the Lilienthal's position as the first aviator of the mankind, because there were similar attempts long before the era of Lilenthal. It is known for instance that in ancient China were built kites the size of a current hang glider today, that could easily carry a man. It is also known the case of George Cayley who in 1852 built and tested a flying apparatus by his own design. But there are other examples.

-*Traian Vuia* (b. Aug. 17, 1872, Bujoru, Caras-Severin County, in Austro-Hungary - d. September 3, 1950, Bucharest, Romania) was a romanian inventor and aviation pioneer. On 18 March 1906 he achieved the first self-propelled flight with a heavier than air apparatus, taking off from a flat surface. He started the construction of his flying machine in the fall of 1904, with the design and construction of the engine. Since 1904 it granted patents for his inventions. The mechanical works are completed since February 1905 but the aircraft wasn't been ready until December, after being mounted its engine. It will become the "Vuia I" or "The Bat" because of the shape of its wings. It had a total weight of 250 kg, with a bearing surface of 14 m², equipped with a 20 HP engine. The experiments began in 1905, with the car version, the wings being folded. In the March 18, 1906 at Montesson, near Paris, the apparatus "Vuia I" was experienced in flight. After a runway of 50 meters, the flying machine rose into the air at a height of three feet and flew a distance of 12 m, at which the propeller blades were stopped and the plane landed.

-*Henri Marie Coanda* (b. Bucharest on June 7, 1886 - d. Bucharest on 25 november 1972) was a prolific romanian inventor best known for his pioneering work in aviation and the achievement of the lenticular aerodyne.

Thus, in 1910 he invented, built and experienced at Issy-les-Moulineaux field, near Paris, the first jet aircraft. In 1934 he obtained a patent in France for "*Method and device for deflecting a stream of fluid that penetrates another fluid*", which actually refered to the phenomenon known today as the "Coanda effect".

The applications of this phenomenon led him in particular to some important results in terms of aircraft hypersustentation. Thus he concluded that the aviation technology is fundamentally flawed and thus laid the foundation for other technologies, at which the principles was very different and the aerodynamic of aircraft differed substantially from the classical models, the new concept being able to obtain outstanding technical and flying performances, as was the case of the so-called "lenticular aerodyne."

From the perspective of this paper, our attention is focused on a very special application that Coanda gave to his “lenticular aerodyne”,- the so-called " Coanda flying epaulettes ", an advanced individual flying apparatus.

-*Viktor Schauberger* (b.30 June 1885 - d.25 September 1958) was an austrian inventor and visionary, forest ranger by profession. As a naturalist, he observed with great attention the natural phenomena and tried to explain and reproduce them artificially with the aid of the devices which he invented. Among his most important discoveries, it should be noted that it was the first to observe the wrong principle of operation of the classic propeller (which in general terms is the principle of the inclined plane) and made a new device ("the repulsin") for the replacement of the classic propellers.

For this new device he found applications both in energetics and propulsion. Later, he worked for the Nazi and there are some informations (unverified and unconfirmed officially) that he would designed and built a series of small experimental aircrafts, equipped with "repulsine".

-*Rudolf Liciar* is a german-romanian inventor who lived in Brasov in the interwar period. He was borned probably at the end of the XIXth Century in the Austro-Hungarian Empire, and he was been a long time fellow countryman with Viktor Schauberger.

In the present day, it is not known exactly in what context they met and how how Liciar had come to know a large part of the technological secrets held by Schauberger. It is known, however, that such technological informations, Liciar has obtained by entering in conntact with the austrian and german personnel of the numerous delegations which visited the industrial and agricultural regions of the eastern part of the Austro-Hungarian Empire. It is assumed that in this context, at some point, he could even met Viktor Schauberger himself.

The fact is that Liciar made the same observations as Schauberger about the wrong principle of operation for the propeller, except that, Liciar called the method as "*vacuum-propulsion*" and the device was called "*cyclonoid*". Also, Liciar worked several years for the Nazis and it was assumed he would have made some small aircrafts, which were later known under the generic name of "*foo-fighters*". The method of vacuum-propulsion can be applied in the field of energetics and propulsion, in the latter case, “*the cyclonoid*” (or “*the repulsin*”, according to Schauberger) could be achieved in two manners: sustentation (lift) cyclonoid and propulsive cyclonoid. The practical application to which we refer in this paper is mainly based on the technology invented by Rudolf Liciar.

-*Virgilius Justin Capra* (b. February 22, 1933 at Magureni, Prahova, Romania) is a romanian inventor. From the multitude of his inventions, innovations and experimental constructions, the most interesting from the perspective of this paper is the Capra's invention of 1956, when he made the first flying jetpack, an individual flying apparatus equipped with mini-rocket engines. Justin Capra has made over the years many models of small vehicles or motorcycles, trying to develop models for serial production, characterized by low fuel consumption and acceptable performance of maximum range, autonomy and reliability.

2. THE SPECIFIC PROBLEMS

The last two centuries have not some notable performances officially recorded, in achieving of a small individual aircraft which would be capable to enable the long flight in conditions of economicity and reliability.

With the development in the field of propulsion systems, these have increased their fuel consumption and become more and more complex and subject to risks of failure.

We mentioned that there were no such performances which be *officially* recorded, knowing that in a more discreet regime, if not secret, some inventors and/or builders apparently managed to obtain outstanding performances: it is the case of Henri Marie Coanda, Rudolf Liciar and similarly, Viktor Schauberger. Perhaps the invention attributed to Liciar, belongs to its origin, to Schauberger, but the detailed work of Schauberger is still unknown, and in that case we will rely on the known inventions of Rudolf Liciar.

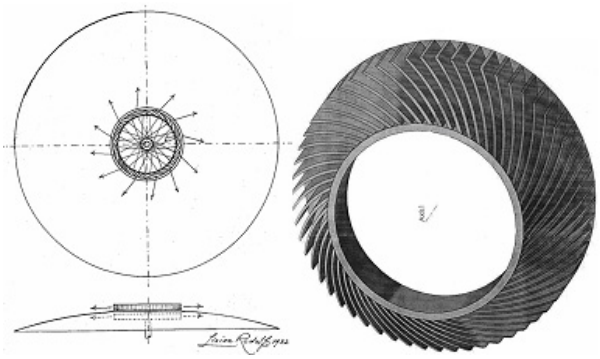

Fig.1 The Cyclonoid- its general configuration (right).

The *Cyclonoid* is actually a compressor machine with a completely and utterly special design, its configuration is such as to allow the achievement of vacuum in the space between the blades and the air exhaust after a trajectory that describes a cycloidal line; then the air jets can be taken by a stator device to steer them in a convenient way, virtually in order to use their energy, which is wasted at the classic propeller. The *cyclonoid* rotor (**left**) is disposed in the center of a (semi)lenticular aerodyne and the air jets expelled from the space between the *cyclonoid* blades, are used to blow the extrados of the semilenticular hypersustentation surface; the air jets exhausted from the *cyclonoid* have a laminar flowing regime, describing cycloids that start from a common center. By moving vertically, up and down, the *cyclonoid*, the vertical, static or downward flight is achieved. This is made by using semi-discoidal surface for hyper or hipo-sustentation, by blowing the jets of air above or below the semi-lenticular surface.

As observed ever since the first attempts of making an individual flying machine, from technological standpoint arose a number of impediments: the relatively large bearing surface (cca.15m^2) necessary to support in the air of a man of medium build, which has made to fail all the attempts to achieve artificial wings that could catch on the pilot's arms (to be manually driven); the need for a prime mover (a machine that transforms energy from/to thermal, electrical or pressure to/from mechanical form) capable of high power but also compact and light enough so that it can be worn by a man, condition virtually fulfilled only by the Coanda and Liciar inventions; the need for a compact and easy folding flying apparatus, which can be easily attached on the human body, in a short period of time; the condition as the prime mover possess enough autonomy and does not require an expensive fuel or complicated technology for the fuel supply system; regarding its structure and functioning, the individual flying machine must not involve major hazards and also it must be characterized by an acceptable level of reliability.

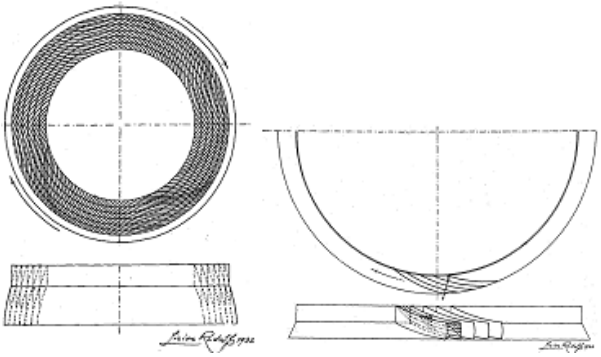

Fig. 2 *Cyclonoidal* rotors

Left overlapped so that their blades to be disposed one in the extension of the other, and

therefore the surface between the blades to be increased, known that as the surface over which the vacuum is made, is higher, the performance will be better.

The cycloidal blades (**right**) forming segments which are placed at equal angles to each other and bordered at their upper side by the wall of the ring device on which the blades are mounted, so that the air cannot invade the space between the blades once it has been ejected from there, the moment when the rotor reached the tangential speed of 396 m/sec.

To meet all these criteria, according the technology used by Coanda and Liciar, the author of this paper proposes the following solutions in order to build an experimental/ demonstrative individual flying machine:

-the use of *vacuum-propulsion* technology to ensure the vertical take-off/landing without the need for use of the same method throughout the flight, but necessarily during the take-off; the optional use of the same technology to achieve a relatively high speed propulsion inside the dense layers of the atmosphere;

-the use of flexible wings partially manually driven, which must be a folding wing, and allows the controlled modification of geometry in order to achieve the flight maneuver during gliding or propelled flight; this flexible and fully folding wing would allow the gliding and safe landing in case of failure of mechanical sustentation and propulsion system, regardless of flight altitude; also, it would allow the long-marsh gliding flight, using the atmospheric streams;

-the achievement of the individual flying apparatus must apply a hybrid formula between the classic glider (improved by adopting the bat wing mechanism used as a mobile wing, not rigid, manually operated) and the sustentative/ propeller *cyclonoid* invented by Liciar, devices which will be relatively small and the pilot could worn them as a knapsack; at take-off, the pilot would use only the sustentative *cyclonoid* then he will open the folding wings and optionally, the propeller *cyclonoid*. At a sufficiently altitude, he may shut down the sustentation/propulsion engines and continue the gliding flight.

3. THE AERODYNAMICS OF THE *CYCLONOID*

When a body is moving through the air or in other fluid environment, against its displacement is exerted the resistance of the environment, the value of which varies depending on the shape of the body and its speed. If we take the case of a body which fall from a great height, its speed would increase according the laws of mechanics (regarding the motion in gravitational field, the fall of bodies) but at the same time, it would increase the air resistance (the drag) that opposes motion. When the two forces (weight and drag) come to be equal, it will reach an equilibrium and hence the movement of the body become uniform, compared to the initial constant acceleration. We say therefore that *the speed limit* has been reached. But if we take the case of a plane that moves at a speed of 100 Km/h, it is similar to the case in which the plane would stand still and the wind would move with the speed of 30 m/sec, the device thus supporting a pressure of 100 Kg/cm^2. The locomotive of a train moving at a speed of 100 km/h will have to consume approx. ½ of the power to overcome the air resistance (the drag) ! Despite the huge progress made in the last two centuries in the field of aerodynamics and its applications, the laws of aerodynamic drag are not fixed, because they depend on many factors. However, it have been determined in practice a series of general formulas that give satisfactory results and therefore it does not insist on this. For example, the first determination of the laws for aerodynamic drag, more empirical, was made for speeds between 4 and 60 m/ sec. At higher speeds, the laws are changing. Currently, we have adopted some simplistic formulas that seek to give sufficiently accurate values of aerodynamic resistance, regardless of the speed. The changes of the laws of aerodynamics at high speeds are given by the regime of discontinuity. At a speed between 4 and 60 m/sec the aerodynamic drag is lower for a body in the form of a drop of water, moving at the curved part forward. Contrary to the expectations, when a drop of water moves with the sharp part forward, it will face an higher aerodynamic drag.

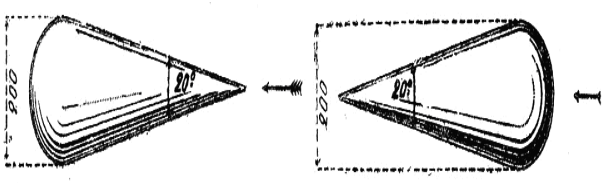

Fig. 3 The case of droplet of water: for the sharp leading edge, the aerodynamic resistance is higher, but with the rounded leading edge and a sharp trailing edge, the aerodynamic drag is lower

For a flat surface, it was observed that the air resistance is a function of surface size, velocity and angle of the direction of motion. In this case, we can say that: R = f (s, v, α) and the variations of this function proved difficult to study. In the case of an orthogonal movement, we have a surface moving in a direction perpendicular to its plane, and the air resistance are given by the relation:

$$R = k \Delta S v^2 \quad (1)$$

so that, the pressure is proportional to the value of surface and the square of speed, where Δ ("delta") is the density of the fluid (air), with the observation that in fact, this relation expressed the lows of Newton but applied to fluid resistance. Note that the relations and the calculation presented in these pages, follow the models applied to the early XXth Century by Rudolf Liciar and Viktor Schauberger. Therefore, they did not work corresponding the IS (International System), but at that time accepted systems. Furthermore, if we consider $k\Delta = \varphi$ and also consider the air as fluid, we have the air resistance expression:

$$R = \varphi S v^2 \quad (2)$$

The determination of φ can be theoretical or experimental. For example, Newton and Poncelet sought to express it depending on the density of air. If the surface *S* is moved orthogonally, it will hit the air volume *Sv*, which put into movement receives the kinetic energy:

$$\frac{1}{2} mv^2, \quad (3)$$

but

$$\frac{1}{2} mv^2 = \frac{1}{2} \cdot \frac{\boldsymbol{s}\boldsymbol{v}\,\Delta}{g} v^2, \quad (4)$$

wherein $\Delta = 1.293$ Kg/m^3 at t = 0 ^{0}C and p = 760 mmHg.

In this situation, the mechanical work developed because the aerodynamic drag is Rv and will be equal to the kinetic energy, ie:

$$R \cdot v = \frac{1}{2} \cdot \frac{\boldsymbol{s}\boldsymbol{v}}{g} v^2 \quad (5)$$

or

$$R = \frac{\Delta \cdot S \cdot v^2}{2g}, \quad (6)$$

if S = 1 m^2 and v = 1 m/sec, we will have:

$$R = \varphi = \frac{\Delta}{2g} = 0{,}065\ sv^2, \quad (7)$$

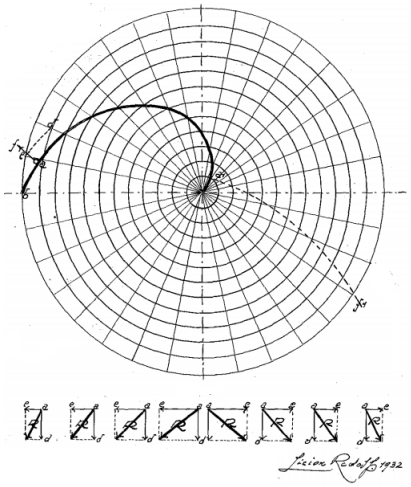

Fig. 4 The *cyclonoid* device (above view), composed of multiple rotors disposed symmetrically.

The cycloidal trajectory of air streams (bold line) from a common center towards the periphery. Such a trajectory is described by the jets of air from all the inter- blades spaces. The air is expelled from the space between the blades to the periphery of the rotor describing cycloids; it is also presented the variation of radial angle but this Newton's coefficient may have much larger values up to 0.13. Especially because φ varies with altitude and temperature. It is already known that φ is dependent on Δ, but Δ varies with temperature and pressure,

according the Gay-Lussac relation:

$$\Delta = \Delta_0 \frac{H}{760} \cdot \frac{1}{1+\alpha t}, \quad (8)$$

where Δ_0 is the air density at t = 0 ^{0}C and p = 760 mmHg

and Δ is the density of air at the temperature t and pressure $p = H$,

$1 + t$ is the binomial of gas expansion, with the value $\alpha = \frac{1}{273} = 0{,}00366$.

Considering all these aspects, Newton was the one who formulated the first law of dependence between drah and other physical quantities, such as: the drag is proportional to the density of the fluid; it is also proportional to the square of velocity; at the same time, it is proportional to the surface; from the point of view of the application mode, the drag is perpendicular to the surface and proportional to the square sine of the incidence angle (angle formed by the studied surface with its direction of movement).

These have been the starting observations, but in fact, the laws of aerodynamics that give us the aerodynamic resistance, are more complex because we must consider not only the action of air on the leading edge of the considered body, but also the action at the trailing edge.

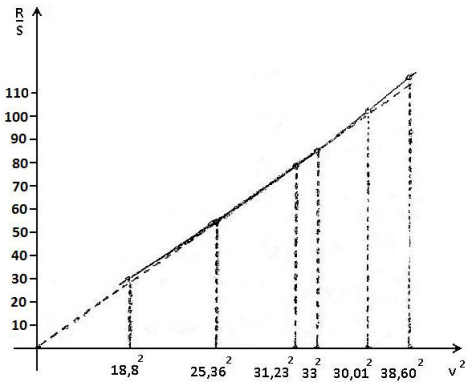

Fig.5 The graph showing the variation of drag/ surface ratio depending on square velocity, according to G. Eiffel

Thereby, the experiments have demonstrated that the drag doesn't vary rigorous with the square velocity and even less with the square sine of the incidence angle.

Obviously, this should not mean that the Newton's observations were not correct, but they was incomplete.

Those comments concerned therefore only one part of the casuistry, ignoring the case of the high speeds, which Newton did not have how to experience during his era.

At present, from the study of the largest part of books and scientific papers of aerodynamics, resulted that the calculation of the drag is often used the so-called "law of square speeds", since it often corresponds to the majority of practical cases.

The reason for this is quite simple: a body moving through the air at a speed v = 1 m/ sec, strikes every second a number M of air molecules, and thus, at the speed v it will hit a number of vM molecules. Therefore, it will result a proportional reaction force, in the first case with $(M \cdot 1)$ and in the second case, with $(M \cdot v)$ where appears the term v^2. As it can be seen, we took into account the existence of friction forces between the molecules, which is acceptable at low speeds but completely unacceptable for high speeds. Since the end of the XIXth Century, after Eiffel's experiences, it was known that it can draw a curve of which ordinates are proportional to the drag on the known surface, and the abscissas are proportional to the square velocity (Fig. 5). If the relation

$$R = \varphi s f(v^2), \quad (9)$$

should be strictly accurate, the experimental curve would have to be confused with a straight line passing through the origin. The drag is then increased by the low pressure formed in the rear side of the studied body, near its trailing edge. To this is added the air compression in the leading edge region, which also enhances the aerodynamic drag, especially in transonic speed regime, and at the emergence of sonic boom, on which the compression makes the maximum effect for that velocity regime.

The maximum speed of the air which is expanded in vacuum was considered that given by:

$$V = \sqrt{2gh}, \quad (10)$$

where h is the atmospheric pressure.

Both the acceleration of gravity and the pressure are given in centimetric values. This is basically the Galileo's relation applied in this case in an interesting way. The question is how calculated from the beginning of the XXth Century, Schauberger and Liciar, the speed of air expansion from the normal atmosphere pressure to vacuum, using the Galileo relation ?

The pressure at sea level is approximately $10^5 N/m^2$ and the standard air density is 1.29 kg/m^3. If we consider as the air density would be relatively constant with the altitude, the height of the column of air required to produce the nominal pressure at sea level, is about 7900~8000 meters. Because the negative gradient of air density is small enough corresponding to the altitude the range of 0~8000 meters, we may thus conclude that the predominant mass of the dense Earth's atmosphere is concentrated in this layer. If it releases an object to fall from a height of 8000 meters and it should ignore the drag, the speed of the object obtained until the impact with the ground, would be 396 m/sec. Therefore, that is the speed reached by an object which falls through a vertical column of air, between the standard pressure at sea level and the pressure which theoretically is considered a relatively "vacuum", at 8000 m height, where the dense atmosphere ended. Of course, in real terms, at H = 8000 m the pressure is not equal to 0 but it is 3.56 x 10^4 Pa, ie about three times lower than at ground level. It is known that, the relation of the baric gradient in the troposphere is:

$$p = 760 \left(1 - \frac{h}{44300}\right)^{5,256} \qquad (11)$$

The air density at H = 8000 m is 0.5252 Kg/m^3 ie approx. 0.43 the density at sea level. According the calculations made in the early XXth Century, resulted a value of 396 m/sec, regarding the above approximations. Because this latter value was considered by Viktor Schauberger the Rudolf Liciar, also being tested in practice, we will consider as valid.

When the considered body will have a higher speed than the above mentioned value, the air will not be able to follow that body, and in the trailing edge region will be not only a low pressure, but vacuum. In this case, because of vacuum, the total drag remains constant.

The aforementioned aspect is very important because the method of *vacuumpropulsion* virtually is based on it, also the technology underlying *cyclonoid*. The device known as propeller, which is a system that uses a series of blades (at least two), which "cut the air" using some edges with the shape of the inclined plane, in order to provide a screwing inside a fluid body (air), which by the axially moving of the device, described an helix in the air.

Therefore, if we consider the example of points situated at the extremity of the above-mentioned device, they should describe in air a helical trajectory. That's why, the device is called "helix" ("propeller", in english), name which has already been consecrated, especially in the in the francophone languages. The thrust/power ratio relative to a conventional propeller is about 3 ~ 7 kgf/1 HP, in recent decades these performances have been improved through the adoption of special propeller configurations, as will be explained below. Moreover, the propeller started from the principle of operation of the bearing surfaces, ie achieving the buoyancy (lift) on the wing of an aircraft. The bouyancy is made with the inclined planes action on the jets of air which hitt the leading edge of the wing, with relatively high speed.

From their interaction with the inclined plane, results the frictional force that opposes to movement, tending to contribute to reducing the speed, but also contributes to the lift force. It follows from this brief description that the bouyancy within the classic wing is achieved by the conjugated action of the air flow on the inclined plane and the drag that arises from this interaction.

As correctly observed the inventor Rudolf Liciar since 1923, this principle of operation *is fundamentally wrong*. Unfortunately, this wrong principle of operation has been taken from the case of wing (bearing surface) and also used to produce thrust/propulsion, the case of propeller.

The propeller, generally, is a mobile rotary wing, which blows the air sufficiently strong,

so that the air jets strike *the inclined plane* (the edge of propeller blades) at a high speed and by the screwing of propeller in the air, it is thrown backwards to provide a reaction force to be used for thrust or propulsion, as the propeller is positioned on front side or rear side of the aircraft. The ratio between the developed thrust and the power consumption is therefore small, and if we try to increase the size or the number of blades, the propeller becomes too heavy and it has other disadvantages related to the gyroscopic torque etc. Because of the need for resistance, the propeller blades must be sufficiently thick, which increases their total weight and the aerodynamic drag. Therefore, the modern propellers are big and heavy, presenting high aerodynamic drag, among other inconveniences.

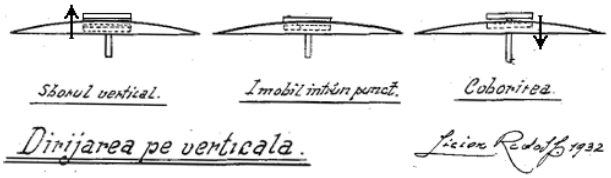

Fig.6 The *cyclonoid* rotor for vertical flight is positioned above the hipo-hypersustentation surface, on which it blows the air so that on the upper surface of this semi-lenticular device is made a low pressure boundary layer; for static flight (hover) the *cyclonoid* would be placed in the middle position, so that it blows the air equally on the extrados and intrados of the hipo-hypersustentation surface, to reach a state of equilibrium; for the descending flight the *cyclonoid* have to be moved under the intrados of hipo-sustentation surface and blowing it with air, it creates a low pressure in the underside, which gives rise to a force applied from top to bottom (hipo-sustentation) contrary to the lift force.

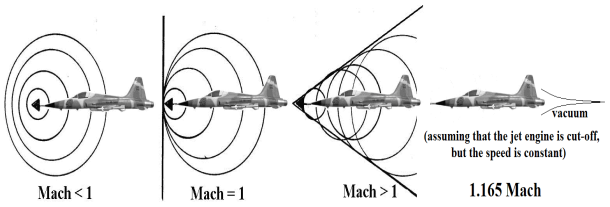

Fig.**7** The mechanical waves formed around a moving body in the atmosphere, once again demonstrates the operation of the *cyclonoid*: at subsonic speeds the air jets (on the aircraft) formed around it mechanical waves which have a spherical configuration, propagating as spherical waves; at transonic speed regime, the air tends to compress in front of the aircraft, greatly increasing the drag, and if the geometry of flying machine is not appropriate, the forces become so high that tend to destructure the plane. If it manages to resist and to enter in the supersonic flight regime (above Mach 1 = cca.340 m/sec = 1224 Km/h) the shock wave tends to detach from the surface of the flying machine, which actually exceeds the sonic waves, having a speed greater than these. At the speed of 396 m/sec (about 1.165 Mach) the air can no longer invade the region behind the trailing edge of the supersonic flying machine, where it will form the vacuum. Exactly on this phenomenon is based the *cyclonoid* and the method of *vacuum-propulsion*

Another big problem of conventional aviation propellers and wings is the control of the air jets flowing regime in the boundary layer region.

This flowing regime is the one that determine further the aerodynamic drag and the flying quality, because in certain situations (turbulent flow, the detachment of air jets from the wing surface) it occurs the loss of bouyancy and the uncontrolled flying trajectories.

To a large extent, the blades of the propeller reproduce the operating principle of the wing, except how the propeller is twisted along its length to facilitate the air flowing without its prematurely detachment from the blade surface.

Since the early XXth Century, it became evident for some scientists that the propeller has not good characteristics for this use: to ensure the lift force and the propulsion for an aircraft.

Both Viktor Schauberger and Rudolf Liciar have realized that the optimum device for lift and propulsion have to be small, lightweight, durable and based primarily on the pressure difference between the region above of a parallel plan to the direction of motion, and the rear side region (the trailing edge) where the pressure have to be in excess.

It is also known the fact that the pressure at sea level is 1033 g/cm^2 and the expansion

speed of the air in vacuum is 396 m/sec,- if the air on the upper surface of a horizontal plan situated in the atmosphere at sea level, should be completely evacuated and another air masses cannot took its place, the lift force made under this plan will be in accord with the atmospheric pressure below the plan, ie 1,033 Kg/cm^2 .

In general, the attempts to modernize the propeller started from the observation that the efficiency of compressors and turbines is typically higher than the propeller efficiency, so it tries to make for the propeller a similar configuration, like the aviation compressor models.

Models of new propellers having multiple and twisted blades were adopted, and the rotor/ stator assembly, like the classic compressor has. Despite an overall improvement in performance, the reconfigured propeller on the model of aviation compressor, continued to have the same major disadvantages related to its poor yield, the gyroscopic effect and the transverse orientation of the exhausted air jets. Other attempts to improve the performance of the propeller, often aimed at: preventing the air jets to move laterally by placing a cowl around the propeller, avoiding the turbulence of the axial air flow by using a stator guiding device (similar to that used at the conventional axial compressors) and to adopt the solution of orientable engines (thrust vectoring or thrust vector control) provided with multiple propellers equipped with relatively large twisted blades; thereby, it attempted the reducing of drag and increasing the efficiency.

But usually, the technological difficulties assumed by adopting all these improvements, proved to be greater than the benefits. Therefore, such propellers often have only an experimental status, and their performances are not at all convincing.

Special applications of *vacuum-propulsion* method could be: to make UAVs with discoid or spherical shape, with outstanding flight performances; to create an individual flying apparatus for paratroopers and scouts; to achieve high speed military aircraft, like the aerospace vehicles etc.

CONCLUSIONS

Vacuum-propulsion technology proposed the use of certain rotary devices generically similar to classic aviation propeller or compressor (centrifugal or axial), but able to create on the upper surface extreme low pressures. This aspect leads to many advantages in terms of simplifying the aircraft technology and a significant increase in flight performances. The author therefore proposes to introduce to the attention of military research the *vacuumpropulsion* method and even to achieve a small individual flying apparatus for experimental and/or demonstrative use.

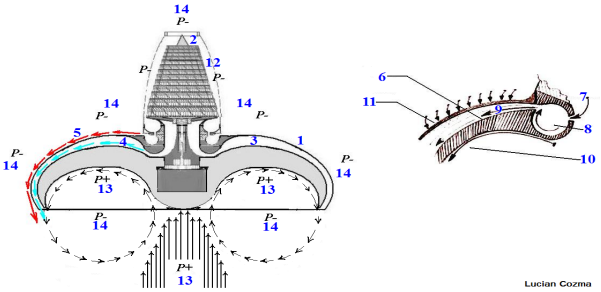

Plate 1. An example of *cyclonoid* application, the high-speed aircraft type Liciar-Coanda: 1- the porous wall is provided with orifices having a diameter between 1.5 and 3 mm, according to the total size of the surface; 2- the shaft is mobile, therefore the cone for conversion of the shock wave can be moved forward and backward; 3- the flowing surface is provided with helical guiding blades (aerodynamic fins); 4- the relatively cold air is drawn axially, and then it will be blown on an inner surface provided with spiral guiding blades (fins); 5- the mixed jet, consisting of exhausted flue gases and cold air; 6- the flowing surface which vortexed the fluid jets; 7- the pressure chamber (where it is the compressed air); 8- the combustion chamber; 9- Coanda profile and the exhaust slot; 10- the cool air jet from the intrados; 11- the porous wall; 12- the multistage propulsive *cyclonoid* (according to Rudolf Liciar patent); 13- the low pressure region; 14- the high-pressure region; 15- the supply installation and the power source

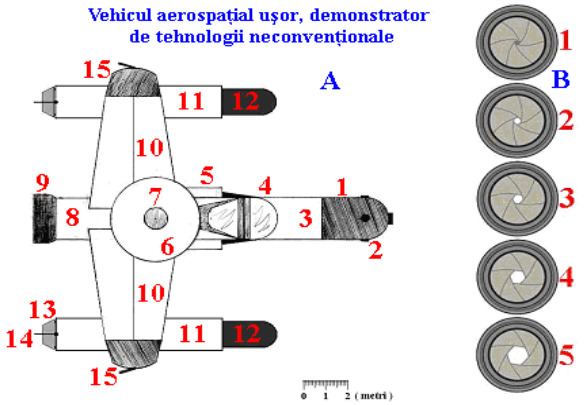

Plate 2- In figure A: 1- *thrust vector control* engine used especially for orientation/ stabilization in the upper atmosphere (provided with a steam generator type Vuia-Moraru, which works anaerobic) supplied with high-pressure jets of steam; 2- system of fixed pairs of mini-nozzles which are oriented antagonist-symmetric (up-down, left-right); it ensures the vector controls (*thrust vectoring* or *thrust vector control*- TVC); also 15 are orientable nozzles; 3- the pressurized compartment; 4- the cockpit; 5- the air intakes of main engine (at the advanced models it renounced at the air intakes in favor of the *wings with internal flowing*, which are systems of propulsion themselves); 6- surface hypersustentation (as a folding diaphragm) on which is flowing the air blown by the *cyclonoid*; 7- the *cyclonoid* type Liciar-Schauberger; 8- the service module; 9- the MHD accelerator of the main engine;

10- the wings; the improved variants are equipped with internal flowing surfaces with "profile Coanda" and the air intake is even the leading edge of the wing, the nozzle being disposed along the entire trailing edge of the wing, and inside the nozzle are placed flight control surfaces like the vanes which deflect motor exhaust; at the extremities of wings can be observed the small nozzles (15) which can move up and down by 15^0, working antagonistic and being in fact some reactive ailerons; 11- the electrothermal jet engines; they use annular compressors (*cyclonoid*) type Liciar and microwaves to heat the compressed air; for supplying of the ultra high frequency coil it would use a klystron operating in pulsed power, which is in its turn powered by a capacitive electrostatic high voltage generator; 12- the cones for conversion of the shock wave; they are designed with leading edge hemispherical (as well as the leading edge of fuselage) since this form is more advantageous for hypersonic speeds in the upper atmosphere; 13- vector manoeuvring elevons (mechanical deflection vanes or paddles enables jet deflection) disposed in the nozzles airflow, at the auxiliary engines;

14- the vertical stabilizer with the rudder are also conceived as a *thrust vector control* being disposed in the nozzle of the jet engine; 15- the reactive ailerons also work as *thrust vector controls*. In figure B: 1- the device denoted by 6 in fig.A is folded; 2, 3, 4- it is opened gradually as a diaphragm, gaining a domed shape; 5- when the aperture is open, in the central area can move up/down the *cyclonoid* 7 on its axis.

BIBLIOGRAPHY

1. the patent RO 21370 from 1933, belonging to Rudolf Liciar;
2. CARAFOLI, Elie si OROVEANU, Th., *Mecanica fluidelor* vol.1-2, Editura Academiei RSR, Bucuresti 1952;
3. DUMITRESCU, Horia si altii, *Calculul elicei*, Editura Academiei române, Bucuresti 1990;
4. group of authors, *Fizica aplicată la războiu*, Litografia Scolii Militare de Infanterie, cca. 1920;
5. IACOVACHI, Ion si COJOCARU, Ion, *Traian Vuia- viata si opera*, Editura Stiintifică si Enciclopedică, Bucuresti, 1988;
6. IACOVACHI, Ion si COJOCARU, Ion, Henri Coandă- viata si opera, Editura Stiintifică si Enciclopedică, Bucuresti, 1988;
7. LIPOVAN, George, *Traian Vuia- realizatorul zborului mecanic*, Editura Tehnică, Bucuresti 1956;
8. SĂLĂGEANU, Ioan, *Aerodinamica vitezelor subsonice*, vol.1-2, Editura Academiei Militare, Bucuresti 1981;
9. SĂLĂGEANU, Ioan, *Aerodinamica vitezelor mari*, Editura Academiei Militare, Bucuresti 1987.

FRACTAL SECTOR STRIPLINE ANTENNA WITH DISKS

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Abstract: *The paper presents a model of fractal antennae having as resonant elements stripline disks with resonant slots. The content highlights the analysis of resonance phenomenon and technical design features accompanied by experimental results. Covering a very wide frequency band, having small geometric dimensions and satisfactory gain, this antennae is recommended in mobile telephony, RFID and multiservice.*

Key words: *antenna, fractal, stripline, Bessel function*

1. INTRODUCTION

The need for miniaturization of communication devices, particularly mobile ones, led to the use of antennas as small as possible.

Along with the reduction in size, these antennas must ensure high bandwidth coverage, keeping as much as possible their gain and efficiency at an optimum level. Another requirement imposed in the realization of such an antenna is the low cost price.

Stripline fractal antenna disc sector described in this article meets those requirements.

Contents of the paper refer to analysis of the phenomenon of resonance, technical realization of the antenna and experimental results.

2. DYNAMICS OF RESONANT FREQUENCY

Take into consideration (as reference) the analyze of the electric field resonance in a discoid cavity with radius r (Best, 2003) (Morariu, 2009), particularly the expression of the resultant electric field E_T, and extrapolating to a finite and tidy string of radius r_i, it is deducted the global variation of the electric field for a fractal segment or fractal sector, as are briefly presented in the following.

$$E_T = E\left(1 - \left(\frac{\omega r}{2c}\right)^2 \frac{1}{(1!)^2} + \left(\frac{\omega r}{2c}\right)^4 \frac{1}{(2!)^2} - \right.$$
$$\left. - \left(\frac{\omega r}{2c}\right)^6 \frac{1}{(3!)^2} + \cdots\right)$$
$$E_T = E\left(1 - \left(\frac{\omega r}{2c}\right)^2 \frac{1}{(1!)^2} + \left(\frac{\omega r}{2c}\right)^4 \frac{1}{(2!)^2} - \right.$$
$$\left. - \left(\frac{\omega r}{2c}\right)^6 \frac{1}{(3!)^2} + \cdots\right) \quad (1)$$

$$E_{T_i} = E\left(1 - \left(\frac{\omega r_i}{2c}\right)^2 \frac{1}{(1!)^2} + \left(\frac{\omega r_i}{2c}\right)^4 \frac{1}{(2!)^2} - \right.$$
$$\left. - \left(\frac{\omega r_i}{2c}\right)^6 \frac{1}{(3!)^2} + \cdots\right)$$
$$E_{T_i} = E\left(1 - \left(\frac{\omega r_i}{2c}\right)^2 \frac{1}{(1!)^2} + \left(\frac{\omega r_i}{2c}\right)^4 \frac{1}{(2!)^2} - \right.$$
$$\left. - \left(\frac{\omega r_i}{2c}\right)^6 \frac{1}{(3!)^2} + \cdots\right) \quad (2)$$

By noting:

k - fractal multiplier coefficient;

j - multiplication fractal level;

r_0 - reference disc radius (the lowest disc radius),

it results:

$$r_i = r_0 k^i r_i = r_0 k^i \quad (3)$$

$$i = 0 - ni = 0 - n \quad (4)$$

$$\frac{x_i}{2} = \frac{wr_i}{2c} = \frac{wr_o}{2c} k^i \frac{x_i}{2} = \frac{wr_i}{2c} = \frac{wr_o}{2c} k^i \quad (5)$$

Applying the electric field superposition property results:

$$E_T = \sum_{i=0}^{n} E_{T_i} = \sum_{i=0}^{n} E_i J_{0_i}$$
$$E_T = \sum_{i=0}^{n} E_{T_i} = \sum_{i=0}^{n} E_i J_{0_i} \quad (6)$$

where:

$$J_{0_i} = J_0(x_i) J_{0_i} = J_0(x_i) \quad (7)$$

and

$E_{T_i} E_{T_i}$ – the evolution of the border electric field on the disc level i;

J_0 - zero-order Bessel function.

Arranging in matrix form parameters in the above relationship is obtained:

$$J_0 = j_{00} + j_{01} + j_{02} + \cdots j_{0n} = \sum_{i=0}^{n} j_{0i}$$
$$J_0 = j_{00} + j_{01} + j_{02} + \cdots j_{0n} = \sum_{i=0}^{n} j_{0i} \quad (8)$$

$$j_{0i} = \left(\frac{x}{2i}\right)^{2i} \frac{1}{(i!)^2} (-1)^i$$
$$j_{0i} = \left(\frac{x}{2i}\right)^{2i} \frac{1}{(i!)^2} (-1)^i \quad (9)$$

$$K = [k_{ij}] K = [k_{ij}] \quad (10)$$

$$k = k^{i2j} k = k^{i2j} \quad (11)$$

$$E = E_{00} + E_{01} + E_{02} \ldots + E_{0p} = [E_{0j}]$$
$$E = E_{00} + E_{01} + E_{02} \ldots + E_{0p} = [E_{0j}] \quad (12)$$

$$E_{Oi} = E_{Ti} E_{Oi} = E_{Ti} \quad (13)$$

The matrix representation of the electric field global evolution on an arm of the antenna is:

$$E_T = [E_{0j}] \prod_{i=0}^{n} [j_{0i}] [k_{ij}]$$
$$E_T = [E_{0j}] \prod_{i=0}^{n} [j_{0i}] [k_{ij}] \quad (14)$$

3. TECHNICAL REALIZATION OF THE ANTENNA

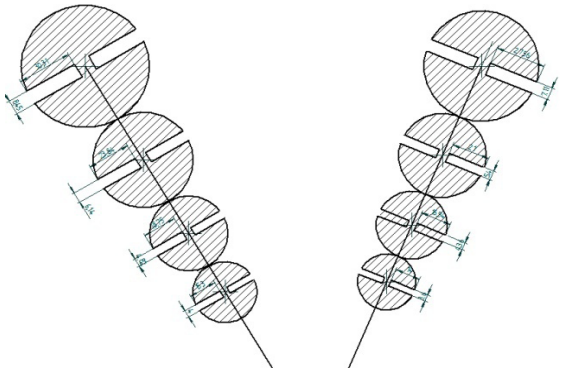

Fig. 1. Design scheme of the radiating surface

The discs have lateral parallel slots. The figure does not show total symmetry because both the corresponding circles on the two axes, as well as afferent slots have different sizes. By connecting the fractal elements creates a radiating surface network that works both independently and in combination, extending the frequency range of the antenna.

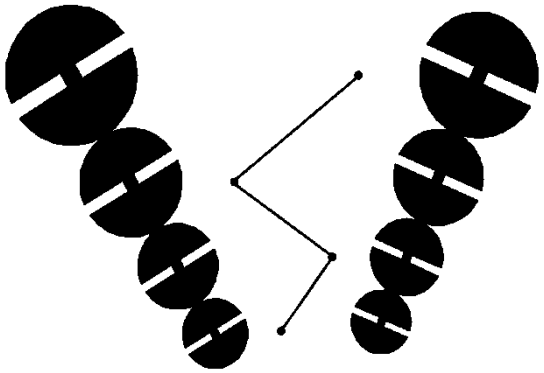

Fig. 2. Antenna radiating surface

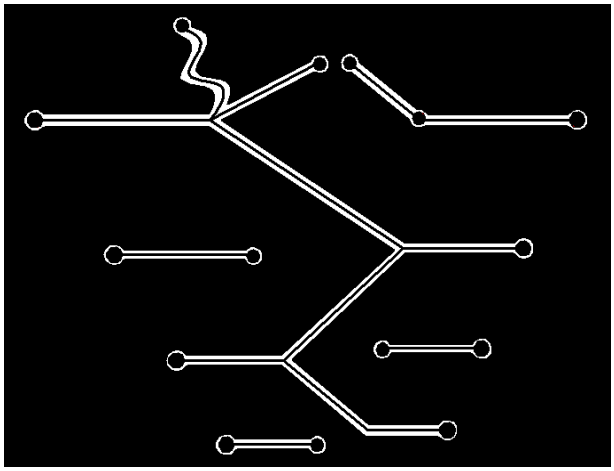

Fig. 3. The rear part of the antenna (connecting elements and feeder matching)

Determination of dimensions. Taking into account the parameters of the stripline support that will accommodate antenna network, the size of each element must be taken so as to ensure a minimum distance λ between each element located in the same direction. Also, due to the number of elements in the network, 8, their arrangement will be on two oblique arms, symmetrical ($\Phi = \pi / 8$) as will be seen later on. For a correct layout ensures framing of the frequencies of each dipole within 2GHz- 5GHz. Thus for each element is calculated wavelength, length of lateral slots and socket median length.

If the above mentioned range (3GHz) is divided to the 8 elements, we obtain the necessary step of the wavelength calculation for each dipole (375MHz). For the first dipole the start frequency is 2GHz.

$$\lambda = \frac{c}{f} \Rightarrow \lambda_1 = \frac{c}{f_1} = \frac{3 \cdot 10^8}{2 \cdot 10^9} = 0.15\text{m}$$

$$\lambda = \frac{c}{f} \Rightarrow \lambda_1 = \frac{c}{f_1} = \frac{3 \cdot 10^8}{2 \cdot 10^9} = 0.15\text{m} \quad (15)$$

$$\frac{\lambda_1}{2} = 7.5\text{cm} \frac{\lambda_1}{2} = 7.5\text{cm} \quad (16)$$

Dipoles are λ / 2, and the size of the socket and slot must be a division as small as the wavelength.

First dipole socket:

$$p_1 = \frac{\lambda_1}{16} = \frac{15}{16} = 0.9375cm$$

$$p_1 = \frac{\lambda_1}{16} = \frac{15}{16} = 0.9375cm \quad (17)$$

Its slot will be calculated as a fraction of 1/12 of the wavelength, relative to shortening factor. Let s_1 slot size:

$$s_1 = \frac{\lambda_1}{12} \cdot \frac{1}{\sqrt{\varepsilon_r}} = \frac{15}{12} \cdot \frac{1}{1.48} = 0.8446cm$$

$$s_1 = \frac{\lambda_1}{12} \cdot \frac{1}{\sqrt{\varepsilon_r}} = \frac{15}{12} \cdot \frac{1}{1.48} = 0.8446cm \quad (18)$$

Analogously will be calculated the dimensions for the other dipoles, based on the wavelength determined taking into consideration the previous dipole frequency and adding the necessary step.

The table 1 presented below, contain the design parameters of each dipole.

Table 1. The design parameters of the dipoles

Dipole	Frequency [GHz]	λ [cm]	λ/2 [cm]	Socket [cm]	Slot [cm]
1	2	15	7.5	0.9375	0.844594595
2	2.375	12.632	6.316	0.78947	0.711237553
3	2.75	10.909	5.4545	0.68162	0.614250614
4	3.125	9.6	4.8	0.6	0.540540541
5	3.5	8.571	4.2855	0.53571	0.482625483
6	3.875	7.742	3.871	0.48387	0.435919791
7	4.25	7.059	3.5295	0.44118	0.39745628
8	4.625	6.486	3.243	0.40541	0.365230095

Data on electrical measurements obtained from experiments are presented in sequential order as follows: directivity diagrams, characteristic impedance variation, E field border diagram, Smith charts obtained for diferent frequency domains (through vector analyzer - VNA).

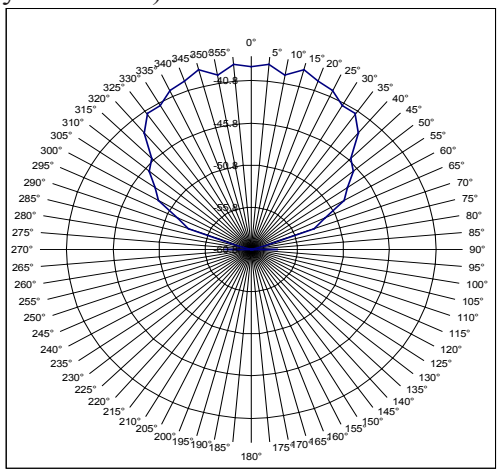

Fig. 4. Directivity diagram - horizontal polarization

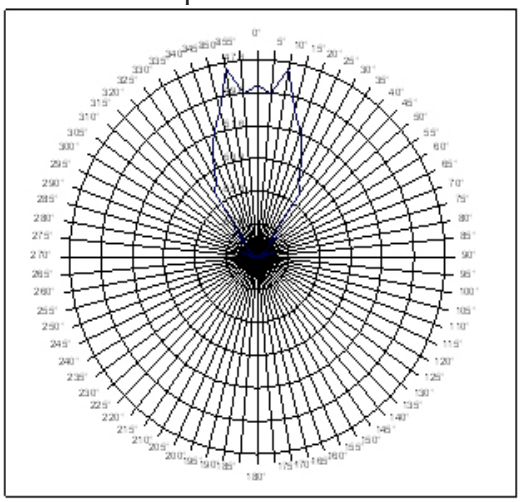

Fig. 5. Directivity diagram - vertical polarization

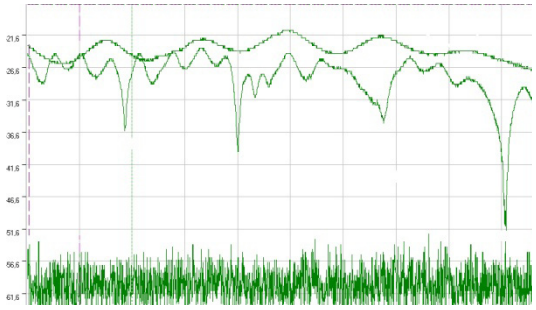

Fig. 6. Characteristic impedance variation

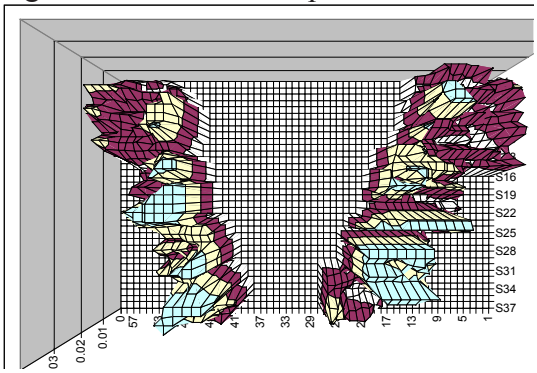

Fig. 7. E field border diagram (mapped)

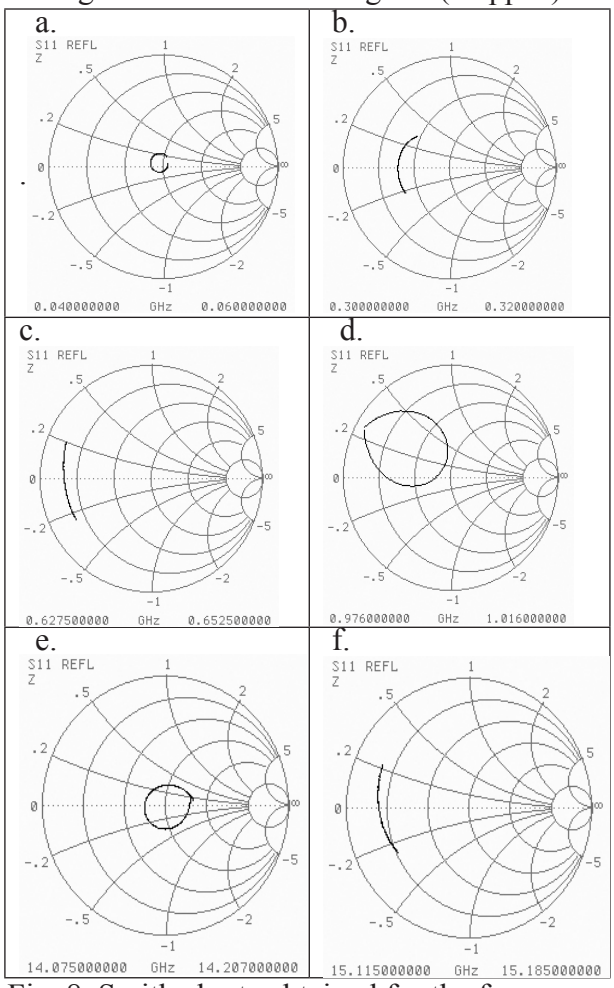

Fig. 8. Smith charts obtained for the frequency domains: a. 0.04-0.06GHz; b. 0.3-0.32GHz; c. 0.6275-0.6525GHz; d. 0.976-1.016GHz; e. 14.075-14.207; f.15.115-15.185

Notable frequency bands are between 50MHz and 100MHz, around the frequency of 150MHz, 310MHz, 465MHz, 600MHz, 1GHz, 13GHz, 14GHz and up to 16GHz.

Antenna gain shows values from 4.4dB to 5.9dB for transmission and from 4.4dB to 5,4dB for reception (outcomes from experiments).

CONCLUSIONS

Remarkable results below 1GHz recommended antenna for use in the 433MHz ISM band. Other applications could include RFID and multi-service applications.

The production cost of the antenna is a small one.

The modest gain in some portions of frequencies spectrum can be considered as a disadvantage of this type of antenna.

BIBLIOGRAPHY

1. Albers, D. J., Alexanderson, G. L. (2008). *Benoit Mandelbrot: In his own words*. Mathematical people: profiles and interviews. Wellesley.
2. Best, S. (2003). *A Comparison of the Resonant Properties of Small Space-Filling Fractal Antennas*. IEEE Antennas and Wireless Propagation Letters (1): 197–200.
3. Kumar, R., Malathi, P. (2010). *On the Design of CPW - Fed Ultra Wideband Triangular Wheel Shape Fractal Antenna*. IJMOT, vol. 5 no. 2, p. 89-93
4. Morariu, Gh., Alexandru, M., Miron, M., Romanca, M., Machedon-Pisu, M., Dobrescu, A. (2009). *Experiment-supported study on the bipolar disk microstrip antenna*. EU Annals of DAAAM & Proceedings, Vienna, Austria.
5. *fractal_antenna.html* [online]. Available: http://www.m0wwa.co.uk/page/M0WWA [2014]

LIFT CAPABILITY PREDICTION FOR AERODYNAMIC CONFIGURATIONS

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Abstract: *This paper presents a mathematical model of the flow around the helicopter rotor airfoil in order to predict the lift capability. The proposed solution consists in an airfoil with filled cavity, where the filled body is a rotating cylinder. The effect on the flow around the airfoil is the generation of vortices that reduce the flow separation downstream of the cavity. The CFD results were compared with those obtained by panel method and this suggests the possibility of a delay in flow separation on the upper surface for the retreating blade. Taking into account that the advancing blade operates at low angle of attack but at high subsonic or transonic conditions, whereas the retreating blade operates at low Mach numbers and high lift coefficients, this new airfoil type could improve the lifting capability of the rotor blade and may lead to new rotors optimized for greater performances in both hover and high speed forward flight.*

Keywords: *helicopter aerodynamic, panel method, rotor blade, vortex strength.*

1. INTRODUCTION

The aerodynamic characteristics of helicopter rotor airfoils must be assessed at their actual operational Reynolds numbers and Mach numbers.

The maximum lift coefficient, $C_{l\max}$, can be used as one indicator of the significance of viscous effects.

At the low end of the practical Reynolds number range for rotors, most airfoils have relatively low values of $C_{l\max}$.

This is because the viscous forces are more determinant, the boundary layer is thicker and the flow will separate from the airfoil surface.

The maximum lift that can be developed by an airfoil when operating at a steady angle of attack is related to the type of stall characteristic of that airfoil.

At low speeds, airfoils generally fall into three static stall categories, namely thin airfoil stall, leading edge stall and trailing edge stall.

The measurements show that thin airfoil and leading edge stalls can be fairly sensitive to changes in airfoil shape, whereas trailing edge stall is insensitive.

Most conventional helicopter rotor airfoils fall into the category of trailing edge or leading edge stall types at low to moderate Mach numbers. It is also common for a mixed stall behavior to occur on some airfoils which is a stall characteristic that is not clearly one type or another [1].

Airfoils designed for helicopter applications have traditionally been obtained through a long evolutionary process in which various levels of theory and experimental measurements have been combined in the pursuit of airfoil shapes with higher values of maximum lift, better lift-to-drag ratios, lower pitching moments and higher drag divergence Mach numbers.

In general, these requirements are conflicting, making the design of general purpose rotor airfoils extremely challenging.

Instead, various families of airfoils have been developed and optimized to meet the specific needs of different parts of the rotor blade.

The use of different airfoils along the blade is made easier because of computer-aided design and composite manufacturing capability which involves only small additional costs over blade made with a single airfoil section.

The selection of airfoil sections for helicopter rotors is more difficult than for a fixed-wing aircraft because they are not point designs. For angle of attack and Mach number varying continuously at all blade elements on the rotor, one airfoil section cannot meet all the various aerodynamic requirements.

The rotor limits may be determined by either advancing blade compressibility effects or retreating blade stall. Because the onset of flow separation may limit rotor performance, there has been a great deal of emphasis in rotor design on maximizing the lifting capability of rotor airfoil sections to simultaneously alleviate both compressibility effects and retreating blade stall. The rotor design point must recognize the influence of both effects as limiting factors as well as allow sufficient margins from the stall/ compressibility boundary for perturbations in angle of attack and Mach number associated with maneuvering flight and turbulent air [2].

At higher angles of attack the adverse pressure gradients produced on the upper surface of the airfoil result in a progressive increase in the thickness of the boundary layer and cause some deviation from the linear lift versus angle of attack behavior. On many airfoils, the onset of flow separation and stall occurs gradually with increasing of angle of attack but on some airfoil (those with sharp leading edges), the flow separation may occur quite suddenly. In the stalled flow regime, the flow over the upper surface of the airfoil is characterized by a region of fairly constant static pressure. The pitching moment about ¼-chord is much more negative because with the almost constant pressure over the upper surface the center of pressure is close to mid-chord. Less lift is generated by the airfoil because of the reduction in circulation and loss of suction near the leading edge and the drag is greater. Under these separated flow conditions, steady flow no longer prevails, with turbulence and vortices being ahead alternately from the leading and trailing edges of the airfoil into the wake [3].

The envelope of rotor thrust limits is the outcome of operation on the blades of stall effects at high angle of incidence and compressibility effects at high Mach number.

As forward speed increases, maximum thrust on the retreating blade falls because of the drop in dynamic pressure and this limits the thrust achievable throughout the forward speed range.

By the converse effect, maximum thrust possible on the advancing side increases but is unrealizable because of the retreating blade restriction.

At higher speeds, as the advancing tip Mach number approaches 1.0, its lift becomes restricted by shock-induced flow separation, leading to drag or pitching moment divergence, which limits the maximum speed achievable.

Thus, the envelope comprises a limit on thrust from retreating blade stall and a limit on forward speed from advancing blade Mach effects [4].

The ability to develop computers methods in performance calculation has been a major factor in the rapid development of helicopter technology.

Results may often not be greatly different from those derived from the simple analytical formulae but the fact that the feasibility of calculation is not dependent upon making a large number of challengeable assumptions is important in pinning down a design, making comparisons with flight tests [5].

2. AIRFOIL BLADE WITH FILLED CAVITY

Two-dimensional simulations were performed for a standard NACA 2412 airfoil with and without cavity.

Both edges of the cavity are sharp in order to fix the separation point (forward edge) and to maximize the feedback loop of the shear layer (rear edge).

The cavity was filled with a rotating small cylinder for improving the circulation around the airfoil (fig. 1).

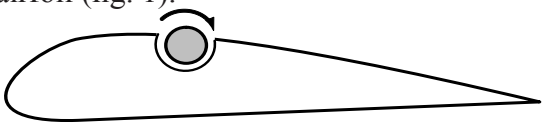

Fig. 1 Airfoil with filled cavity

The computational domain extends to a distance of 12 chords lengths in the upstream and downstream directions and three chords lengths in the upper and lower normal directions.

The distance between the discrete points at which the non-slip condition is enforced needs to be equal to or slightly greater than the grid spacing. The grid resolution and domain size were varied in order to assess convergence and influence of the far-field boundary condition.

The Reynolds number was sufficiently high such that the formation of large scale vortices and the subsequent pairing of these structures gives rise to aperiodic low frequency oscillations that are difficult to characterize because the run times are not sufficiently long to observe many periods.

The CFD results are presented in the figures 2 and 3.

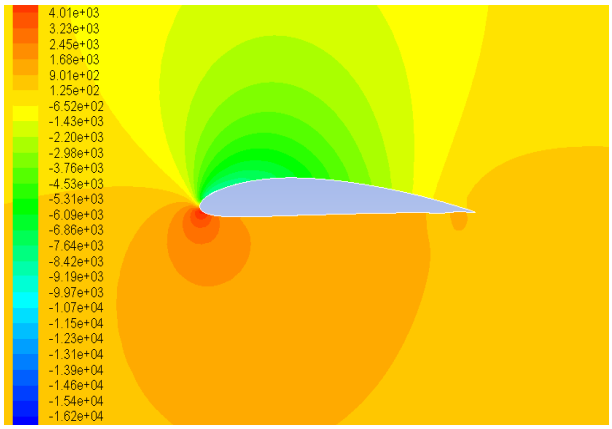

Fig. 2 Airfoil without cavity: pressure distribution

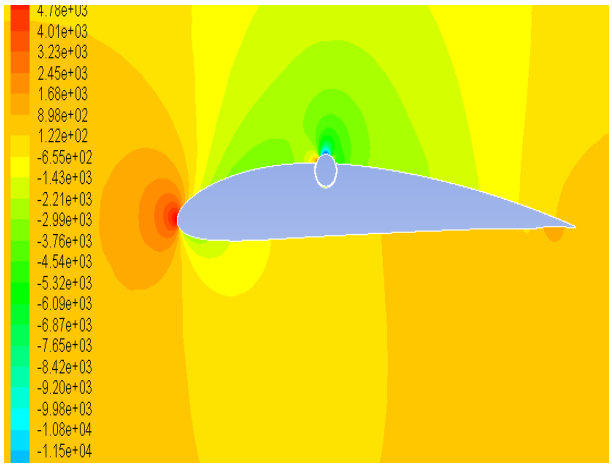

Fig. 3 Airfoil with cavity: pressure distribution

The relative high thickness of the airfoil without a cavity causes a laminar separation which initially starts approximately half a chord length from the leading edge. At very high angles of attack the flow over the airfoil with cavity separates well before the forward edge of the cavity. The separated flow displays a strong interaction with the cavity and this interaction causes the flow to shed smaller scale structures than the airfoil without cavity at the same angle of attack.

3. PANEL METHOD RESULTS

Potential flow over an airfoil of arbitrary shape can be synthesized by combining uniform flow with a curved vortex sheet wrapped around the surface of the airfoil. The concept of replacing the airfoil surface with a vortex sheet is more than just a mathematical device because there is a thin boundary layer on the surface, due to the action of friction between the surface and the airflow, in which the large velocity gradients produce substantial vorticity, hence, there is a distribution of vorticity along the airfoil surface due to viscous effects.

The vortex strength, $\gamma(s)$ must vary along the surface such that the normal component of velocity induced by the entire sheet and the uniform flow is zero everywhere along the surface of the airfoil. In most cases, the strength distribution necessary to satisfy this condition is difficult to be determined analytically. For numerical computations, such sheet can be approximated as a series of flat vortex panels wrapped around the surface of the airfoil (fig. 4).

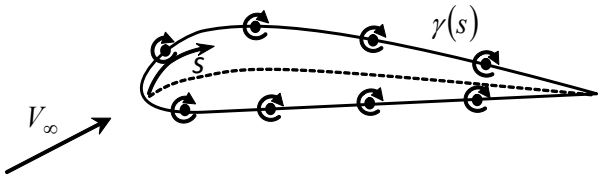

Fig. 4. Vortex sheet

To define the vortex panels, a series of nodes is placed on the airfoil surface, such that the nodes are clustered more tightly near the leading and trailing edges.

The change of variable $x/c = (1-\cos\theta)/2$ provides the desired clustering in x.

The panels start at the trailing edge, are spaced forward along the lower surface, are wrapped up around the leading edge and then run back along the upper surface to the trailing edge so that the last panel ends at the trailing edge where the first panel began.

The vortex strength $\gamma(s)$ of each panel is assumed to be linear along the panel and continuous from one panel to the next.

That is, for the n panels, the vortex panel strengths are $\gamma_1, \gamma_2, \ldots\ldots\gamma_n$, and the main thrust of the panel technique is to solve for γ_j, $j = 1$ to n, such that the body surface becomes a streamline of the flow and such that the Kutta condition $\gamma_1 = -\gamma_n$ is satisfied (fig. 5).

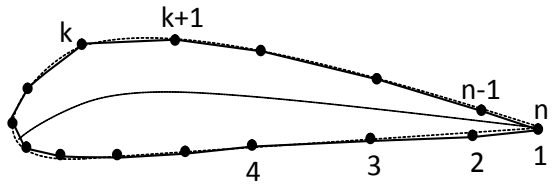

Fig. 5 Vortex panel distribution

To solve for the n unknown nodal vortex strengths, at the center of each panel is defined a control point where the normal component of the flow velocity is imposed to be zero.

For an even number n of nodes, the points x_i, $i = 1, 2, ...n/2$ on the chord line are computed from the following algorithm:

$$\delta\theta = \frac{2\pi}{n-1}, \quad x_i = \frac{c}{2}\left\{1 - \cos\left[\left(i - \frac{1}{2}\right)\delta\theta\right]\right\} \quad (1)$$

The lover and upper surface coordinates for an airfoil can be obtained from the camber line geometry, $y_c(x)$, and the thickness distribution, $t(x)$ as follows:

$$\begin{cases} X_l(x_i) = x_i + \dfrac{t(x_i)}{2\sqrt{1+\left(\dfrac{dy_c(x)}{dx}\right)^2\Big|_{x=x_i}}}\dfrac{dy_c(x)}{dx}\Big|_{x=x_i} \\ Y_l(x_i) = y_c(x_i) - \dfrac{t(x_i)}{2\sqrt{1+\left(\dfrac{dy_c(x)}{dx}\right)^2\Big|_{x=x_i}}} \end{cases} \quad (2)$$

$$\begin{cases} X_u(x_i) = x_i - \dfrac{t(x_i)}{2\sqrt{1+\left(\dfrac{dy_c(x)}{dx}\right)^2\Big|_{x=x_i}}}\dfrac{dy_c(x)}{dx}\Big|_{x=x_i} \\ Y_u(x_i) = y_c(x_i) + \dfrac{t(x_i)}{2\sqrt{1+\left(\dfrac{dy_c(x)}{dx}\right)^2\Big|_{x=x_i}}} \end{cases} \quad (3)$$

For a point x_i on the chord line (fig. 6) we have two nodes on the airfoil, one node on the lower line of the airfoil, $P_{n/2+1-i}$ and the other one on the upper line of the airfoil, $P_{n/2+i}$.

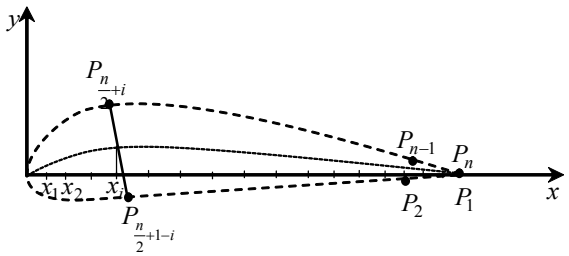

Fig. 6 The upper and lower lines nodes

A second-order panel method assumes a linear variation of $\gamma(s)$ over a given panel and the value of $\gamma(s)$ at the edges of each panel is matched to its neighbors (fig.7).

The flow-tangency boundary condition is still applied at the control point to each panel.

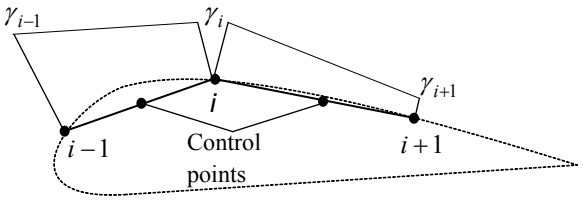

Fig. 7 Linear distribution of $\gamma(s)$

The coordinates of these control points are given by

$$\begin{cases} X_C(i) = \dfrac{X_{P_i} + X_{P_{i+1}}}{2} \\ Y_C(i) = \dfrac{Y_{P_i} + Y_{P_{i+1}}}{2} \end{cases} \quad (4)$$

Each panel is assigned a local panel coordinate system (ξ, η) as shown in fig. 8.

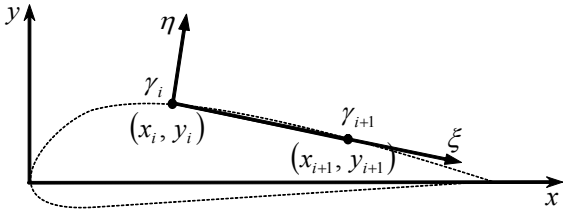

Fig. 8 Vortex panel coordinate system

For each panel, an infinite number of infinitesimally weak vortices are combined in side-by-side fashion as shown in fig. 9.

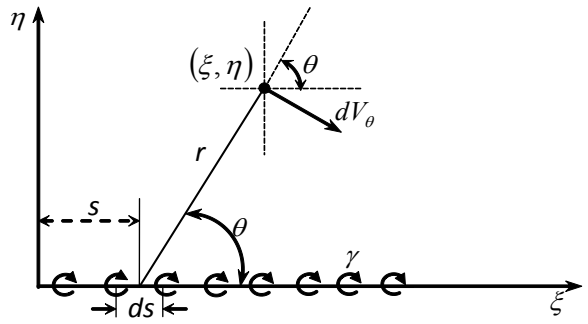

Fig. 9 Edge view of a 2-D vortex panel

Consider a differential segment of a vortex panel that lies on the ξ axis at the location $\xi = s$ and has length ds.

The velocity induced at any point (ξ, η) by this differential vortex is normal to the vector $\vec{r}$ and has a magnitude inversely proportional to the distance between the points of coordinates $(s, 0)$ and (ξ, η), namely $r = |\vec{r}|$. The ξ- and η- components of the velocity induced at the point (ξ, η) by this infinitesimally vortex panel are given by

$$\begin{cases} dV_\xi = dV_\theta \sin\theta = \dfrac{\gamma(s)}{2\pi r}\sin\theta\, ds \\ dV_\eta = -dV_\theta \cos\theta = -\dfrac{\gamma(s)}{2\pi r}\cos\theta\, ds \end{cases} \tag{5}$$

According to fig. 9 we have

$$\begin{cases} \sin\theta = \dfrac{\eta}{r} \\ \cos\theta = \dfrac{\xi - s}{r} \end{cases} \tag{6}$$

where $r = \sqrt{(\xi - s)^2 + \eta^2}$.

It follows that

$$\begin{cases} dV_\xi = \dfrac{\eta\,\gamma(s)}{2\pi\left[(\xi - s)^2 + \eta^2\right]} ds \\ dV_\xi = -\dfrac{((\xi - s))\gamma(s)}{2\pi\left[(\xi - s)^2 + \eta^2\right]} ds \end{cases} \tag{7}$$

A linear vortex strength distribution on the panel j extending from $\xi = 0$ to $\xi = l_j$ has the expression

$$\gamma(s) = \frac{\gamma_{j+1} - \gamma_j}{l_j} s + \gamma_j \tag{8}$$

where

$$l_j = \sqrt{(x_{j+1} - x_j)^2 + (y_{j+1} - y_j)^2} \tag{9}$$

The matrix of the velocities V_ξ and V_η is

$$\begin{bmatrix} V_\xi \\ V_\eta \end{bmatrix} = \frac{1}{2\pi l_j}\begin{bmatrix} (l_j - \xi)B + \eta A & \xi B - \eta A \\ -l_j - (l_j - \xi)A + \eta B & l_j - \xi A - \varepsilon B \end{bmatrix} \cdot \begin{bmatrix} \gamma_j \\ \gamma_{j+1} \end{bmatrix}$$

where

$$\begin{cases} A = \dfrac{1}{2} h\, \dfrac{\xi^2 + \eta^2}{(\xi - l_j)^2 + \eta^2} \\ B = \arctan\dfrac{l_j - \xi}{\eta} + \arctan\dfrac{\xi}{\mu} \end{cases} \tag{10}$$

In order to get the velocity induced by panel j at the control point of the panel i, the coordinates of control point must be expressed from the coordinate system (x, y) in the coordinate system (ξ, η) of panel j, making a rotation with angle β_j and a translation in the point (x_j, y_j) as it follows

$$\begin{cases} \sin\beta_j = \dfrac{y_{j+1} - y_j}{l_j} \\ \cos\beta_j = \dfrac{x_{j+1} - x_j}{l_j} \end{cases} \tag{11}$$

$$\begin{bmatrix} \xi_C(i) \\ \eta_C(i) \end{bmatrix} = \begin{bmatrix} \cos\beta_j & \sin\beta_j \\ -\sin\beta_j & \cos\beta_j \end{bmatrix} \cdot \begin{bmatrix} x_C(i) - x_j \\ y_C(i) - y_j \end{bmatrix} \tag{12}$$

$$\begin{bmatrix} V_x(i) \\ V_y(i) \end{bmatrix} = \begin{bmatrix} P_1(j,i) & P_2(j,i) \\ P_2(j,i) & P_2(j,i) \end{bmatrix} \cdot \begin{bmatrix} \gamma_j \\ \gamma_{j+1} \end{bmatrix} \tag{13}$$

The velocity $V_\eta(i)$ induced in the control point of panel i by panel j is

$$V_\eta(i) = \left(-\frac{y_{i+1} - y_i}{l_i} P_1(j,i) + \frac{x_{i+1} - x_i}{l_i} P_2(j,i)\right)\gamma_i + \left(-\frac{y_{i+1} - y_i}{l_i} P_2(j,i) + \frac{x_{i+1} - x_i}{l_i} P_2(j,i)\right)\gamma_{i+1}$$

The $n \times n$ airfoil coefficient matrix M is generated from the 2×2 panel coefficient matrix in airfoil coordinates, $P(i, j)$ for the velocity induced at the control point i by panel j, extending from node j to node $j+1$, and the n nodal vortex strengths, γ_1 through γ_n are then obtained by numerically solving the linear system

$$M \cdot \begin{bmatrix} \gamma_1 \\ \gamma_2 \\ ... \\ \gamma_{n-1} \\ \gamma_n \end{bmatrix} = V_\infty \begin{bmatrix} [(y_2 - y_1)\cos\alpha - (x_2 - x_1)\sin\alpha]/l_1 \\ [(y_3 - y_2)\cos\alpha - (x_3 - x_2)\sin\alpha]/l_2 \\ ..... \\ [(y_n - y_{n-1})\cos\alpha - (x_n - x_{n-1})\sin\alpha]/l_{n-1} \\ 0.0 \end{bmatrix}$$

Once the nodal strengths are known, the velocity and pressure at any point in space can be computed by adding the velocity induced by all $n-1$ vortex panels in the free stream velocity,

$$\begin{bmatrix} V_x \\ V_y \end{bmatrix} = V_\infty \begin{bmatrix} \cos\alpha \\ \sin\alpha \end{bmatrix} + \sum_{i=1}^{n-1} \begin{bmatrix} V_x(i) \\ V_y(i) \end{bmatrix} \quad (14)$$

The lift coefficient for the entire airfoil is the sum of those induced by all the $n-1$ panels,

$$C_l = \sum_{i=1}^{n-1} \frac{l_i}{c} \cdot \frac{\gamma_i + \gamma_{i+1}}{V_\infty} \quad (15)$$

3. RESULTS

For the clean airfoil at $\alpha = 0^\circ$ the flow initially separates around 50% of the chord length and this separation causes a periodic vortex shedding in the wake of the airfoil. At $\alpha = 10^\circ$ and $\alpha = 15^\circ$ the separation bubble and the vortex structures are larger and the separation point on the suction side moves upstream with increasing the angle of attack. The separated vortices tend to merge into larger structures before being shed into the wake.

The filled cavity has a strong influence on the structure of the flow in the separation bubble. It promotes smaller-scale vortex shedding than would otherwise occur for the airfoil without a cavity at the same angle of attack.

CONCLUSIONS

The section lift coefficients predicted by thin airfoil theory and panel codes are in good agreement with experimental data for low Mach numbers and small angles of attack.

The airfoil with filled cavity gives good results regarding the maximum lift coefficient and the behavior of the helicopter retreating blade.

BIBLIOGRAPHY

1. Gordon Leishman, *Principles of Helicopter Aerodynamics,* Cambridge University Press (2007).
2. Katz J, Plotkin, A., *Low-Speed Aerodynamics*, second edition, Cambridge University Press (2010)
3. Prouty, R. *Helicopter Performance, Stability and Control,* Krieger Publishing Company, Florida, USA (2002).
4. Rotaru, C., Circiu, I., Boscoianu M. *Computational Methods for the Aerodynamic Design*, Review of the Air Force Academy, No 2(17), p. 43-48 (2010).
5. Rotaru, C., Arghiropol A., *Maple soft solutions for nonlifting flows over arbitrary bodies,* Proceedings of the 3rd WSEAS international conference on FINITE DIFFERENCES - FINITE ELEMENTS - FINITE VOLUMES - BOUNDARY ELEMENTS, ISSN 1970-2769, p. 270-274 (2010).

PARAMETER IDENTIFICATION IN RADIO FREQUENCY COMMUNICATIONS

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***Abstract*:** *Modulation detection is an essential requirement for cognitive radio and in this paper is made a comparison between the time-frequency analysis and extraction of distinctive features of signals that allow identification of the type of modulation using the RPA. Using this method it was succesfully detected ASK, QAM and CPFSK modulations.*

Key words: *modulation, detection, RPA, ASK, CPFSK, QAM*

1. INTRODUCTION

The urgent need for resources led to over-exploitation of radio spectrum due to the exponential development of telecommunications technologies. It requires a multilateral approach to deal with optimization of spectrum resources in order to improve and exploit the full potential of the available radio.

This can be implemented both by reviewing current policies for managing radio spectrum and by distributing network intelligence computing through the use of advanced technologies and devices with increased processing power, which able to make decisions on different functional levels using , therefore, optimization algorithms and technologies for electromagnetic management resource allocation.

Intelligence in this context is synonymous with adaptability, or, in other words, changing the behavior of a network device under the action of external factors in the sense of performance optimizing.

A cognitive radio built on a software radio platform is a smart radio [4], context-aware which might be capable of autonomous reconfiguration by learning and adapting to the medium.

The main channel of perception in application is visualization of radio map constructed based on the measured spectral statistics parameters.

One of these parameters is the indicator RSSI (Received Signal Strength Indicator) [3] and as a supplement could be used the parameters obtained from RPA.

2. RECURRENCE PLOT ANALYSIS (RPA)

Recurrence method, RPA, is based on the representation of time series that characterize a process in m-dimensional space called phase space. Then this space is represented as a matrix that registers distance between points in phase space. If this distance is compared to a threshold, we will get the matrix recurrence. According to [1], the method can highlight different signal behaviors studied: steady, unsteady, cyclical fluctuations, etc. Trajectory in the phase space is performed by vectors that have samples as coordinates from time series studied:

$$\vec{v} = \sum_{k=1}^{m} x(i + (k-1) \cdot d) \cdot \vec{e}_k \qquad (1)$$

where $\vec{e}_k$ are unit vectors of state space axes, $x(\cdot)$ represent samples from time series studied, d is the time delay parameter and m is the size of phase space parameter.

These last two parameters are the most important parameters of the method.

After obtaining the phase space trajectory is obtained the distance recurrence matrix.

Its calculation (2) is based on determining the distance between points *i* and *j*, of the path.

Typically, this path is compared with a threshold (3):

$$D(\vec{v}_i, \vec{v}_j) = \left\| \vec{v}_i - \vec{v}_j \right\| \quad (2)$$

$$R(i,j) = \Theta(\varepsilon(i) - D(\vec{v}_i, \vec{v}_j)) \quad (3)$$

where $D(\vec{v}_i, \vec{v}_j)$ is the distance between *i* and *j*, Θ represents Heaviside unit step function and $\varepsilon(\cdot)$ is the selected threshold of recurrent matrix.

After the representation of distances on a colored scale, called distance matrix, if is applied the unit step function Heaviside having chosen a threshold, $\varepsilon(\cdot)$, will be obtained a recurrence representation that will highlight wheather the distance between *i* and *j* is less than $\varepsilon(\cdot)$ or is not.

This distance (below the $\varepsilon(\cdot)$ is shown by black dots placed in the matrix recurrence. In general ε is a constant and *D* is the Euclidean distance.

This distance can be calculated also using other metrics: maximum norm, the norm angular, etc. If the choice of the size of the encapsulation, *m*, it is too small, the trajectory in phase space is m-dimensional projection of the phase space trajectory real.

Thus, m-dimensional phase space trajectory contain adjacent points which in real space are not close.

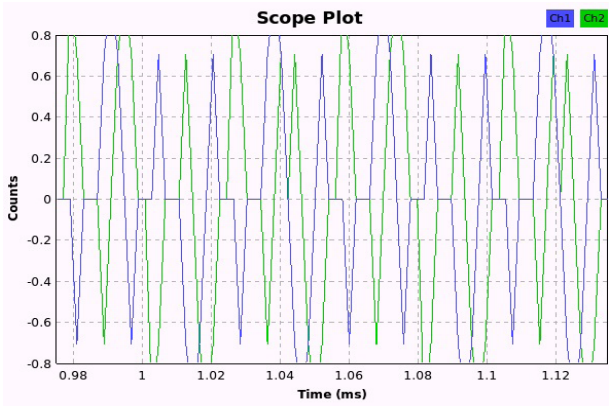
This space could lead to further conclusions that are not correct. However, if m is too great, the set of data comprising phase space and the number of calculations would increase excessively, and would result in a significant increase in computation time and resources used.

Therefore, the most used method for the choice of *m* is the method of false neighbors (FNN - False Nearest Neighbour) [2].

Encapsulation is the optimum size for the measure FNN is almost zero.

3.TIME-FREQUENCY DOMAIN ANALYSIS FOR DIGITAL MODULATION SIGNALS

In the case of the first simulated signal, an ASK modulated signal (2 bits/symbol, amplitude A=1, carrier frequency f_c=64khz), while time analysis seems to offer satisfactory solutions, since what matters is the instantaneous amplitude whitch can be easily detected in the time domain by applying a envelope detection.



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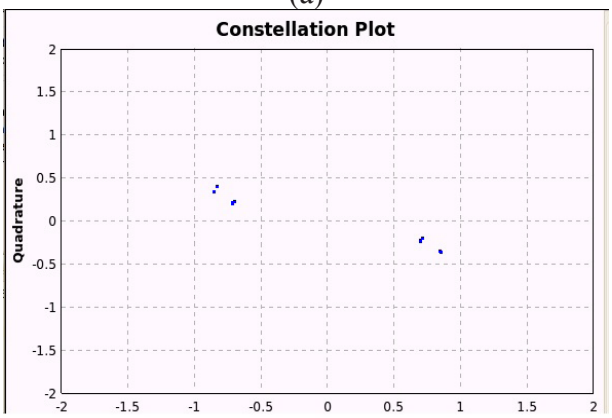

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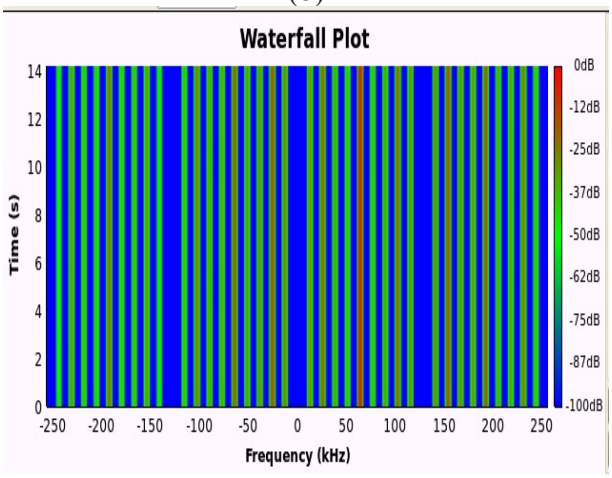

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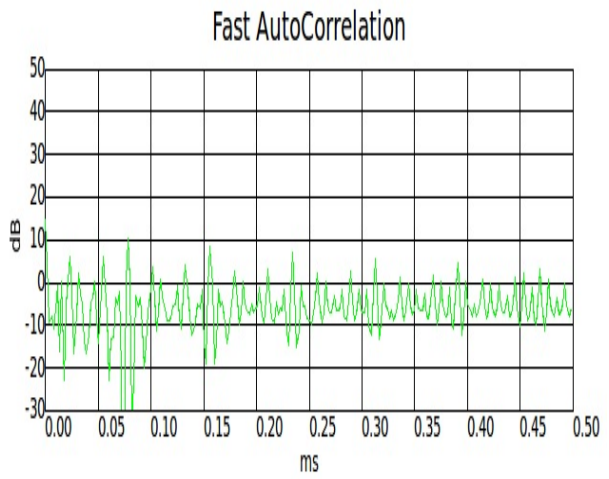
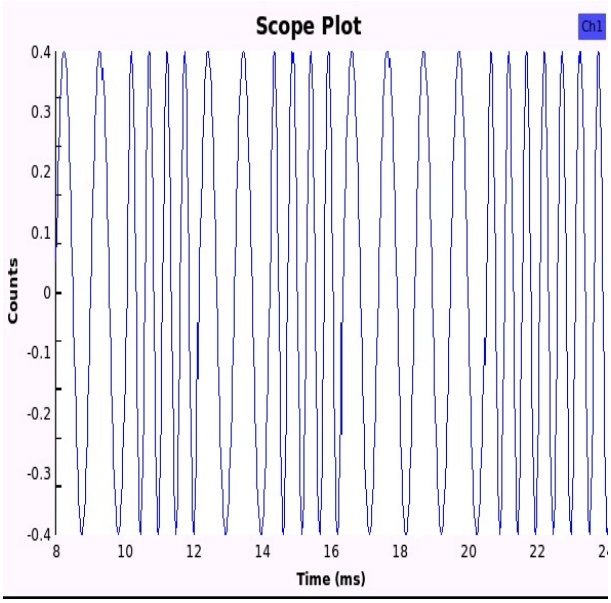


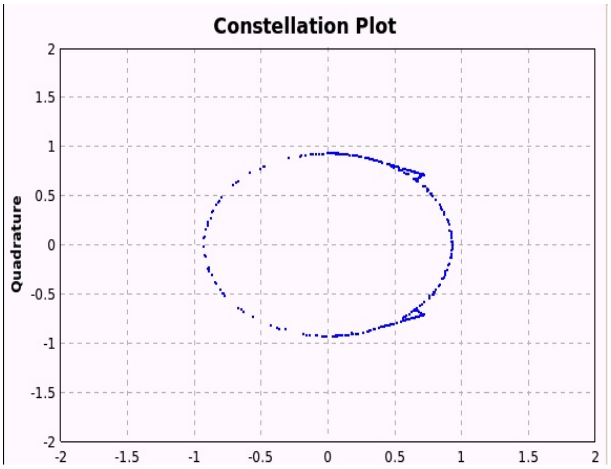
(d)

Fig. 1. (a): ASK signal; (b): ASK signal constelation; (c): ASK signal spectogram; (d): ASK signal autocorrelation

If signal is FSK modulated (the second simulated signal)(200 samples/symbol, 10 symbols, random signal source, 1000 samples) or PSK things are not the same, since the envelope is constant, what matters to these signals is frequency or instantaneous phase shifts and the characteristics can not be obtained directly by analyzing the field time (and even less in the presence of noise).



(a)



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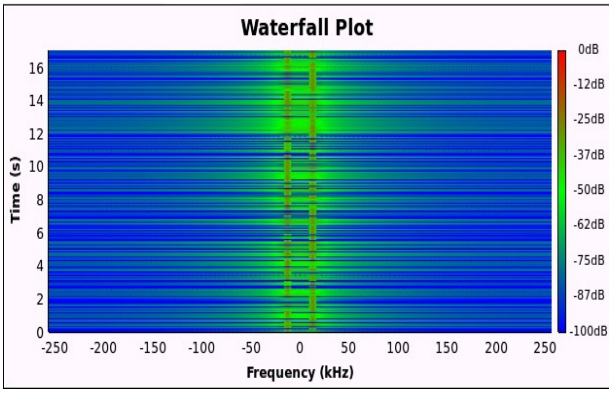

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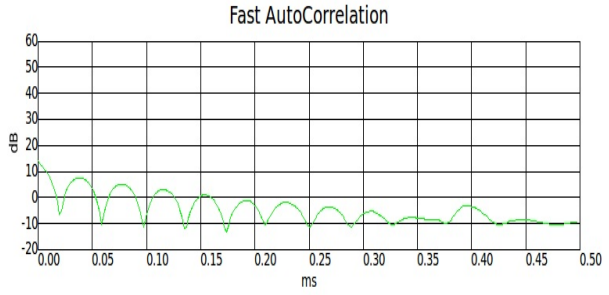


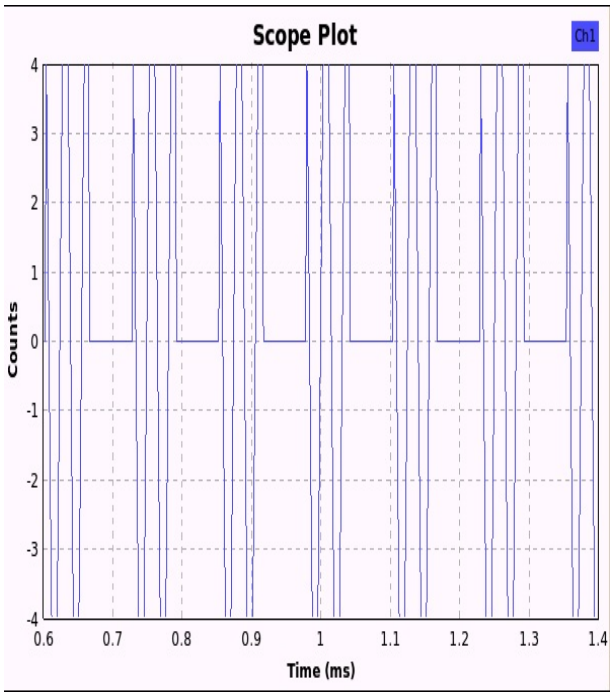
(d)

Fig. 2. (a): CPFSK signal; (b): CPFSK signal constelation; (c): CPFSK signal spectogram; (d): CPSFSK signal autocorrelation

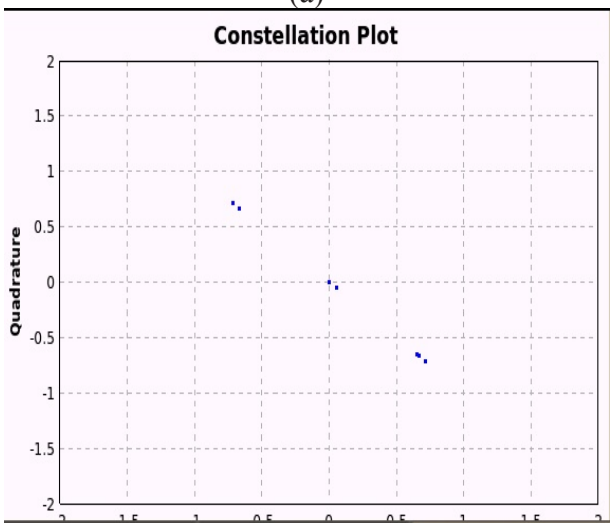
What is specific to any type of digital modulation is that the modulated signal have stationary portions (minimum length equal to the duration of a symbol) and at the time of changing symbols sudden jumps occur in the signal structure.

This can be better seen in the time-frequency diagram and the recurrence of the signal.

An example is the third simulated signal, a QAM modulated signal(square wave signal source, f_i=5khz, amplitude A=1, carrier frequency f_c=20khz), that basically combines PSK with ASK modulation.



(a)



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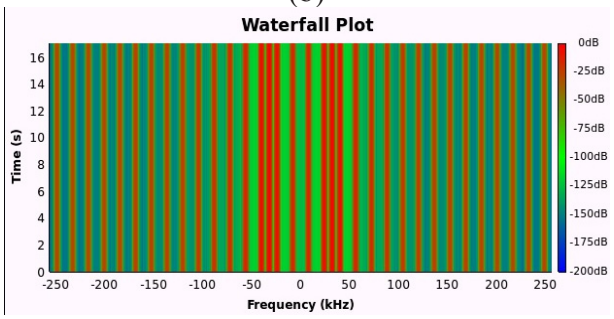

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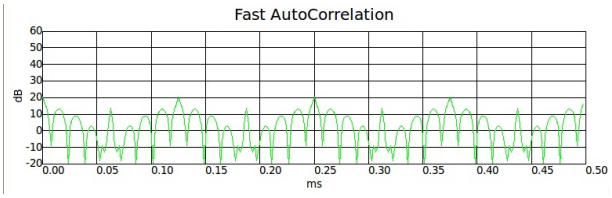


(d)

Fig. 3. (a): QAM signal; (b): QAM signal constelation; (c): QAM signal spectogram; (d): QAM signal autocorrelation

For digitally modulated signals, the Fourier transform does not provide satisfactory solution since it only reveals the spectral content of the signal without giving information about the times at which something changes in the signal structure.

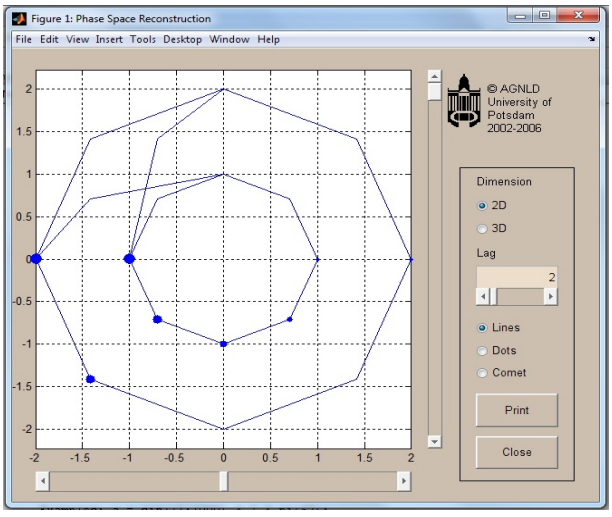
For example, the spectra of the two FSK modulated signals with different bit sequences will show nearly identical.

The spectrogram enables recognition (visually, at least) of ASK and FSK type of modulation.

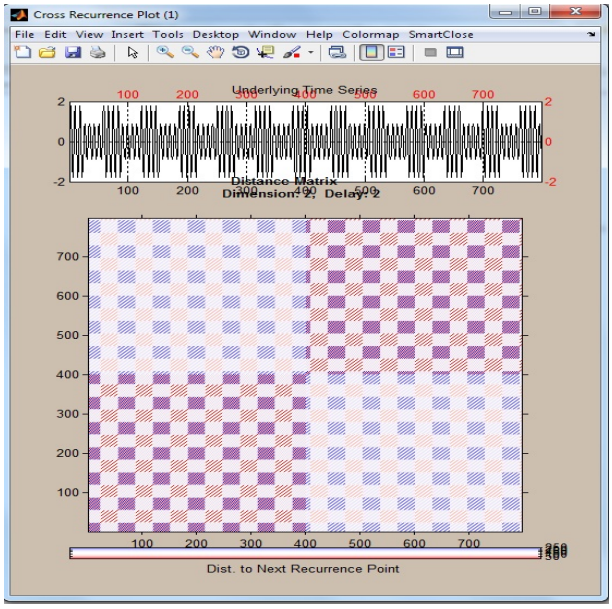
4. RPA ANALISYS OF DIGITAL MODULATED SIGNALS

4.1 Recurrence diagram for ASK modulated signal (first simulated signal).

As the signal frequency remains constant, the graph is made up essentially of diagonal lines parallel to the main diagonal.



(a)



(b)

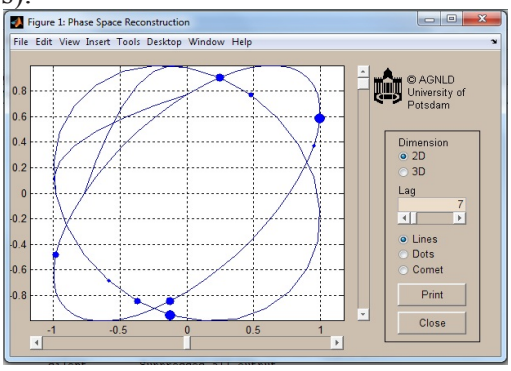
Fig. 4. (a): Phase space representation of ASK signal; (b): Recurrence matrix of ASK signal;

Information on the different signal amplitudes present were lost in the process of obtaining the matrix of recurrence (when the distance matrix binarization was done using it as a threshold parameter).

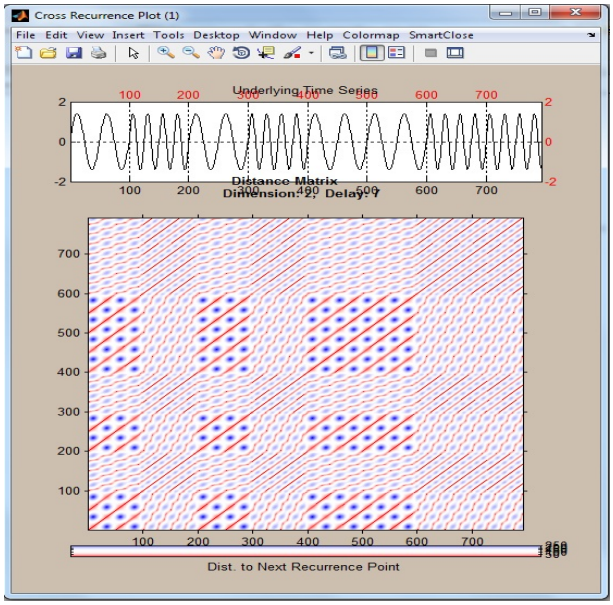
But transitions between areas with different signal amplitudes are visible in the diagram recurrence.

4.2 Recurrence diagram of CPFSK modulated signal (second simulated signal)

The moments of frequency hopping are visible on the recurrence diagram as areas of transition. Going on line identity it is observed when and how the signal frequency range (by observing the distance between the diagonal lines).



(a)

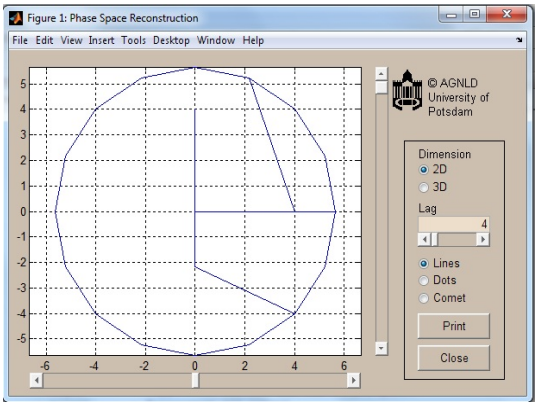


(b)

Fig. 5. (a): Phase space representation of CPFSK signal; (b): Recurrence matrix of CPFSK signal;

4.3 Recurrence diagram of QAM modulated signal

The moments of frequency hopping is visible on recurrence diagram as areas of transition. Going on line identity when and how to visually show the frequency and amplitude of the signal vary and the phase shift introduced by the discontinuities.



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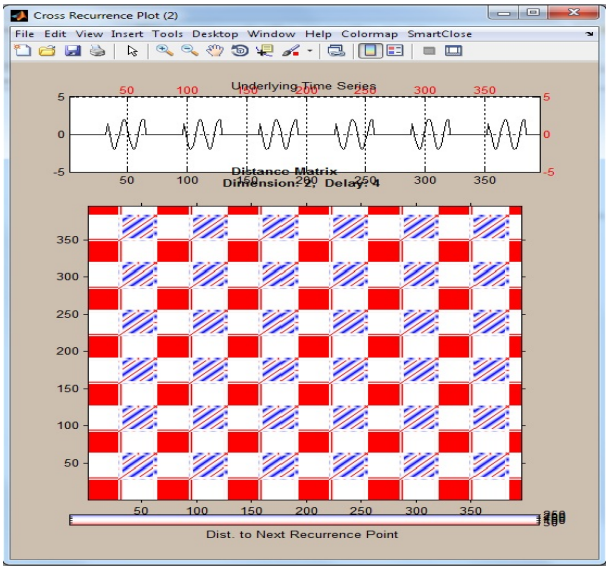

(b)

Fig. 6. (a): Phase space representation of QAM signal; (b): Recurrence matrix of QAM signal;

5. IDENTIFYING THE TYPE OF MODULATION

ASK modulation type can be identified by inspecting the matrix of distances. If the maximum value of the blocks located on the main diagonal of the matrix of distances is approximately constant, then it is an ASK modulation type. FSK modulation type can be identified by inspecting the diagram recurrence. The diagram contains along the identity line blocks formed by diagonal lines (parallel to the identity line), spaced at a constant distance, the distance is approximately the same for all the blocks. In the corresponding recurrence diagram of an ASK signal continuity exists between the lines of all blocks and empty blocks can appear white (when comparing two segments of the signal amplitudes differ greatly).

Obtaining the period of the sine wave is done by summing the (normalized) on the diagonal of the matrix recurrence.

QAM modulations is visually identified using alternating signal areas containing the sine component represented by the lines thicker or thinner depending on the amplitude of the signal with areas where information is not transmitted.

CONCLUSIONS

In this paper it was studied the parameters of radio signals used in communications using two methods.

The first method aims at highlighting the parameters obtained by conventional measurements in the radio frequency signal level, bandwidth, the visual identification of the type of modulation, constellation of digital modulated signals and eye diagram.

The second method involves using signal recurrence for highlighting signal evolution in this way it can be characterized as a periodic or or irregularity , determining the fundamental frequency using recurrence histogram representation in phase space and visual identification of the type of modulation. Recording and processing of signals it was performed using a software radio implementation using GNU Radio.

This approach to the study of signal parameters using software radio can be useful for managing dynamically spectrum resource allocation based on the situation at the time. The great advantage of this method is the ability to adapt to different types of modulation. Its disadvantage is the high consumption of computing resources for the study of a consistent time series. In the detection of digital modulated signals, RPA can be used to provide a first indication of the type of modulation used.

BIBLIOGRAPHY

[1] N. Marwan, *Encounters with neighbours. Current developmentsof concepts based on recurrence plots and their applications*, Ph. D. thesis, Institut für Physik, Fakultät Mathematik und Naturwissenshaften,Universitat Potsdam, May 2003

[2] A.Serbănescu, O. Stănăsilă, F.-M. Bîrleanu - *Analiza neliniară a seriilor de timp* Editura Academiei Tehnice Militare, Bucuresti , 2011

[3] Mihai Ciuc Constantin Vertan *Prelucrarea statistică a semnelolor* Editura MatrixRom 2005

[4] J. Mitola, *Cognitive radio for flexible mobile multimedia communications* in Proc. IEEE Int. Workshop Mobile Multimedia Communications, 1999.

REMOTE CONTROLLED SMARTHOME OVER PSTN

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Abstract: *The concept of remote controlled has become increasingly widespread nowadays due to the need to improve domestic comfort. This project presents the realization of such a system. Smarthome involves interconnecting multiple systems that together lead to the realization of remote command and control for electronic equipment and appliances found in a home or company office. Smarthome over PSTN is such a system, a remote control system that involves the use of fixed switched telephone network to achieve the interaction between the user and the controlled equipment. The whole project was based on the command and control unit - integrated type, a microcontroller.*

Key words: *smarthome, PSTN, DTMF, microcontroller, optocoupler, integrated*

1. THE REMOTE CONTROL CONCEPT - INTRODUCTION

The first remote control tendencies were represented by Nikola Tesla's attempts in 1898 to remote control vehicles or vessels.

Remote control concept was initially considered a difficult area to address, but with the spread of electricity in all homes has become a challenge for researchers and also a need to improve the comfort of their homes.

Smarthome idea complements the concept of automated home (Home Automation), control of the decision being made by human factor from a considerable distance from the ordered items.

2. PUBLIC SWITCHED TELEPHONE NETWORK (PSTN)

PSTN - Public Switching Telecommunication Network is the Public Switched Telephone Network - the largest telecommunications network comprising a total of approximately 1000 million subscribers [9].

This network is used mainly for telephone communications services.

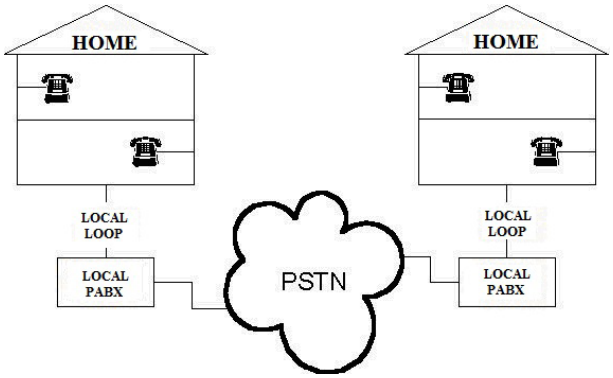

Fig. 1 – PSTN

The main features of the telephone network are:

– subscribers access to analog phone line;

– links and communications are performed in telephone baseband (0.3 - 3.4 kHz);

– switching can be achieved both analog (electromechanical PBX) and digital (electronic PBX) - (64 kbps channels);

– signaling in the network can be done in two methods, "Pulse" and "Tone". Method "pulse" involves interrupting the supply voltage fox example 3 times for number 3, and for the 'Tone' are used DTMF tones.

Table 1. DTMF Frequency

F_{low} \ F_{high}	1209Hz	1336Hz	1477Hz
697Hz	1	2	3
770Hz	4	5	6
852Hz	7	8	9
941Hz	*	0	#

DTMF - Dual Tone Multi Frequency. With these tones are transmitted information from the user to the telephone PBX when the user wants to make a phone call, so the number you wish to call is transmitted digit by digit to PBX as specific signals for each key.

These tones are signals that are included in the telephone baseband (0.3 - 3.4 kHz), so they can be sent during a call, as in the submitted project.

3. DESIGN OF THE DIAGRAM AND FUNCTIONAL BLOCKS

The system is designed to be connected in parallel to the telephone line, so it does not interfere in any way with the usual calls.

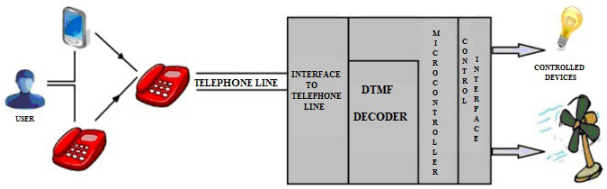

Fig. 2 – Block diagram

The entire assembly is connected to the telephone line through the optocoupler block, whose role is to isolate two independent entities, and adapting the signals in telephone line to the requirements of microcontroller unit.

Signals that appears during the ringing, are counted by the microcontroller and after reaching a pre-established number of bursts, the microcontroller connects the entire circuit to the telephone line, so it answers the call.

The number of square wave bursts in Romanian PBX signaling is 25 bursts/ring.At this point comes into play DTMF decoder with the sole purpose of converting signals specific to telephone line into binary signal that is recognized by the microcontroller.

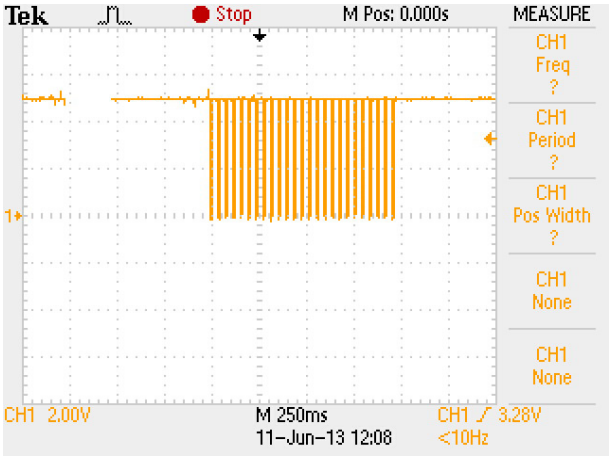

Fig. 3 – Oscilloscope capture for one ring – 25 bursts

The software requires to the caller to enter a password to have access in the system (1990*) after which he can command the device.

The control of devices is via a power block.

The entire activity of the system is coordinated and developed around embedded computing unit - PIC16F84 microcontroller.

3.1 Optocoupler block and interface between the system and the telephone line

The interface that realize the connection between the system and the telephone line is composed of two parts, one that helps adaptation of the control signals occurred on the line and the needs of microcontroller and other part, the physical closing circuit that realize responding to the call.

The first part, one containing an optocoupler (4N25) has the main purpose optical isolation between the proposed circuit and the phone line so there is no interference between these two entities.

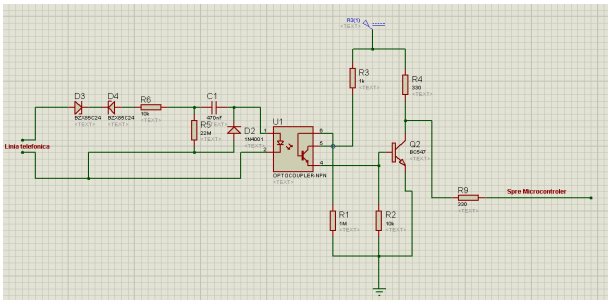

Fig. 4 – Interface between circuit and telephone line

The actual coupling part is represented by a line relay controlled by 5Vdc which is coupled to the controller output. After the controller has decided that the system must be connected to the telephone line, after a preset number of call bursts, it applies on pin RA1 – the logic value 1 - analogical 5VDC, thus coupling the system to the telephone network.

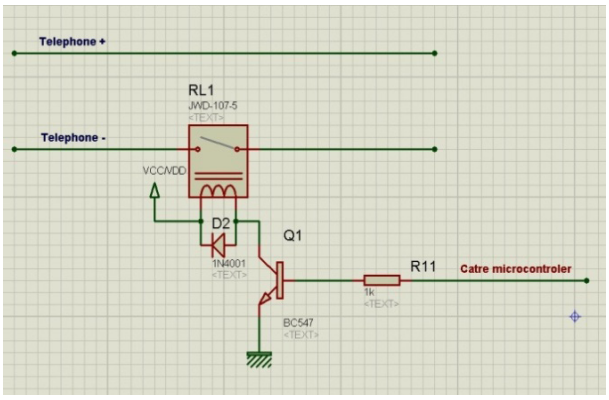

Fig. 5 – Line relay

3.2 DTMF decoder block

The design of DTMF decoder diagram was largely based on the specific application for integrated circuit MT8870.

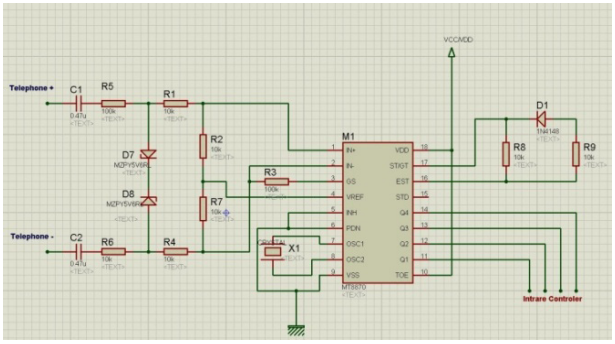

Fig. 6 – DTMF decoder

Block thus created is an interface between the telephone line and the microcontroller. This circuit realize the conversion of the analogical DTMF signal in four bits digital signal that is needed for the microcontroller input.

The analogical DTMF signal is formed from the sum of two sinusoids, specific for each key and the output is a digital information represented by four bits, in accordance with the table bellow:

Table 2 – DTMF frequency and output[2]

Key	Low frequency [Hz]	High frequency [Hz]	DTMF decoder output			
			Q3	Q2	Q1	Q0
1	697	1209	0	0	0	1
2	697	1336	0	0	1	0
3	697	1477	0	0	1	1
4	770	1209	0	1	0	0
5	770	1336	0	1	0	1
6	770	1477	0	1	1	0
7	852	1209	0	1	1	1
8	852	1336	1	0	0	0
9	852	1477	1	0	0	1
0	941	1209	1	0	1	0
*	941	1336	1	0	1	1
#	941	1477	1	1	0	0

3.3 Microcontroller

Generally, a microcontroller is nowadays a complex electronic structure that has as purpose the control of a process in circuits and schematics where it is mounted. In a more general way to control a specific interactions with the environment without need of the human factor. In other words, the controller help automate the system in which it is included.

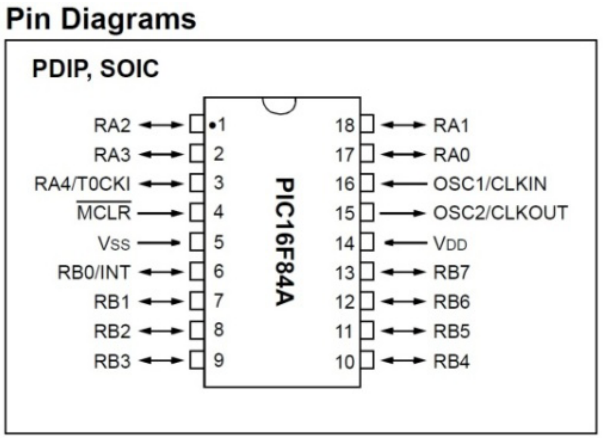

Fig. 7 – PIC16F84A microcontroller

For this project it was chosen an 8-bit microcontroller - PIC16F84A to be used as computing unit. This model is common in many applications and it's features are sufficient to perform properly the requirements of the project.

PIC16F84 has the following features: [3]

- 1KB program memory;
- 68 bytes of data RAM;
- 64 bytes of data EEROM;
- 14-bit wide instruction words;
- 8-bit wide data bytes;
- interrupt source;
- 13 input/output pins;

- 25 mA sink max. Per pin;
- WatchDog Timer;
- 200ns instruction cycle;
- 10.000 erase/write cycles;
- Low power consumption (< 2mA at 5V, 4MHz and < 15uA at 2V, 32kHz).

3.4 Power block

Power block is the block that realize the interface between the controller and the controlled household appliances.

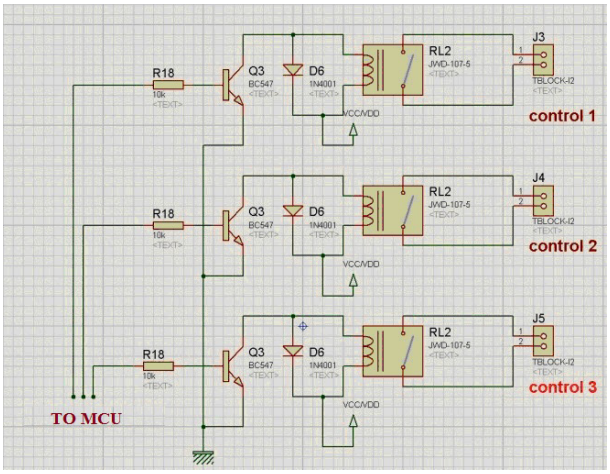

Fig. 8 – Power block

For implementation it was used 5VDC controlled relays whose switch withstands a current of 10A at a voltage of 250V. Voltage and current were chosen at these values because the project considers to control the power supply part of the controlled devices.

3.6 The software

To realize the code and compile it it was used "MPLAB IDE v8.70". Programming language is assembler (ASM). It was chosen this programming language because it is an intuitive programming language for the human factor and the result is optimized and very close to the machine code of the controller.

CONCLUSIONS

The remote control system via telephone line presented in this project is a secure system that allows increasing domestic comfort.

The circuit design is both magnetic and optical isolated from the telephone line and thus does not interfere in any way with it, their functionality is somewhat independently.

Using PIN verification before entering in command menu represents extra security against unauthorized access.

This project is an inexpensive and safe remote control for electrical equipment.

BIBLIOGRAPHY

1. *Curs surse de tensiune constantă* - Universitatea Politehnică Bucuresti ;
2. *Datasheet - CM8870 - decoder DTMF* - http://www.alldatasheet.com/datasheet-pdf/pdf/57010/CALMIRCO/CM8870-70C.html;
3. *Datasheet PIC16F84A Microchip* http://www.alldatasheet.com/datasheet-pdf/pdf/350230/MICROCHIP/PIC16F.html;
4. Gheorghe Muscă, ”*Programare în limbaj de asamblare*”, Teora, 2002;
5. http://www.telecomhelper.com;
6. Note de curs ”*Telefonie analogică*”, Lt. Col. Lect. Dr. Ing. Popescu Florin, Academia Tehnică Militară;
7. Note de curs ”*Telefonie si multiplexare*”, Lt. Col.Conf. Univ. Dr. Ing. Ciotîrnae Petrică, Academia Tehnică Militară;
8. Randall Hyde, ”*The art of assembly language 2nd edition*”, No Starch Press;
9. Tatiana Rădulescu, ”*Retele de telecomunicatii*”, Thalia, 2005.

NETWORK POLICY FUNCTION VIRTUALIZATION VIA SDN AND PACKET PROCESSING

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Abstract: *So far affecting mostly the IT world, the virtualization trend is becoming active in the mobile telecommunications network by the Network Function Virtualization (NFV) initiative, in conjunction with the Software Defined Networks (SDN) concept, of moving network applications from dedicated hardware to virtual containers on commercial-off-the-shelf (COTS) hardware. Policy and charging rule functions are basic and very important elements for the operators of 3G and LTE mobile networks, aiming to monetize at maximum their networks. This paper describes a method for an implementation of the policy function based in SDN and its deployment on the telco specialized COTS platform ATCA (Advanced Telecom and Computing Architecture).*

Keywords: *SDN, network function virtualization, policy rules, ATCA*

1. INTRODUCTION

As the innovation cycles continue to accelerate, legacy telecom hardware-based appliances rapidly reach end of life.

Simply having a hard-wired network with boxes dedicated to single functions is not the optimal way to achieve dynamic service offering and the signal for a change in the network world was given by the SDN concept of separating the control and data plane, followed by the Network Function Virtualization, an ETSI (European Telecommunications Standards Institute) initiative. NFV is a network architecture concept that proposes using IT virtualization related technologies to virtualize entire classes of network node functions into building blocks that may be connected or chained together to create communication services.

Because the network design must be more agile and able to respond on-demand to the dynamic needs of the traffic and services running over it, the solution would be having software implementations of the network functions running in the Cloud, on Data Center infrastructure or on dedicated COTS platforms (like ATCA [7]).

Most of the important telecom vendors have started developing telco virtualized products, some focused on the end-to-end solution, like Ericsson and Huawei, others aiming to virtualize specific parts of the network: Cisco, F5, Juniper, Tekelec etc. Separately, carriers are considering the deployment of SDNs in which packet forwarding is separated from control functions, and the latter are provided via a "controller" function that tells simple packet forwarding devices how to direct flows, based on "Northbound" APIs, interconnected to the OSS and BSS (Operational- and Business-Service Support) systems.

The goal of this paper is to demonstrate a method for policy rules implementation at a centralized SDN controller point and the possible virtualization of the policy network function using a standard ATCA platform with dedicated packet processing and computing modules.

2. PCRF NETWORK FUNCTION VIRTUALIZATION

ETSI's Industry Specification Group for Network Functions Virtualization (NFV ISG) has published the first batch of specifications in October 2013, including an Architectural

Framework based on functional blocks [3] and indicated the first NFV use-cases [4]. Special categories in the indicated use-cases are dedicated to the Evolved Packet Core (EPC) transformation towards NFV: "UseCase#5 Virtualization of Mobile Core Network and IMS" and to Radio Access Network part: "UseCase#6 Virtualization of Mobile base station".

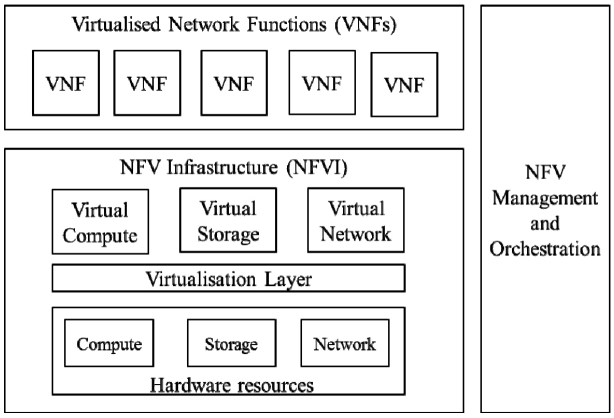

Fig.1 NFV architecture

LTE formally separates the control and bearer planes (it is sometimes called a "SDN-like" architecture), so virtualization of these functions is viewed as attractive [9].

The creation of policy architectures was driven by telecom vendors' and operators' need to find more intelligent ways to allocate resources: differentiated services, real-time control and dynamic offers – from "shared wallet" and roaming control to "happy hour" and toll free – that increase customer loyalty and create new revenue opportunities.

A dedicated policy function was first introduced by 3GPP as part of the IMS specifications. As the interest in policy control increased, 3GPP introduced it as a separate policy platform, which typically includes a policy server and policy enforcement devices (e.g. Deep Packet Inspection, DPI appliances), often also connected to charging systems and subscriber databases, that can be generically named PCRF (Policy and Charging Rules Function).

Policy entities [1] are used to help operators to dynamically control the way that users and applications consume data network (IP and Internet) resources.

Policy decisions can be based on a wide variety of triggers, including a customer's data volume usage, service tier, location, application, URL, time of day, congestion level and so on [6].

The all-IP "connected anywhere" concept evolution has introduced different types of users and profiles for the mobile network, including M2M or industrial communication, with different QoS, security and traffic bandwidth profiles: in some cases the user would be highly mobile and consume a lot of bandwidth, and thus require a particular EPC, traffic management and security configuration; whereas another type of service may be more static and predictable, and thus require a different workflow configuration (see Fig. 2, as proposed in [2]).

The policies became more complex and different for each case so, similar to the service creation for Intelligent Networks based on service building blocks (SBBs), the policies are created and adapted based on specific "workflows", which could be easily implemented in software, at SDN controller level, as we will detail in the next paragraph.

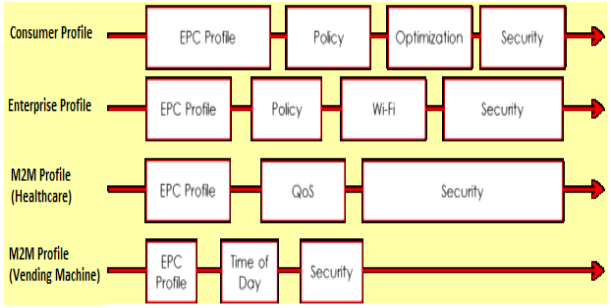

Fig. 2 Different scenarios ("workflows") for policy function building blocks

In each scenario, a service definition is created for each user type or application, and a workflow is configured accordingly.

3. POLICY RULES IMPLEMENTATION USING SDN

The Software Defined Networking (SDN) is a new architectural concept that aims to decouple the network control and forwarding functions [8].

This separation enables the network control layer to be programmable, which is an important advantage for real-time traffic discrimination in case of elastic PCRF implementations. Furthermore, SDN uses the OpenFlow protocol that was specially designed to include packet processing techniques like *match* and *modify actions* for the flow entries.

The OpenFlow wire protocol is used for establishing a control session, defining a message structure for exchanging flow modifications (flowmods) and collecting statistics, and defining the fundamental structure of a switch (ports and tables).

In an OpenFlow flow entry, the entire packet header (at least the layer 2 and layer 3 fields) are available for match and modify actions, so basically the DPI is natively considered as part of SDN. That is why implementing the policy function using SDN is maybe one of the most straight-forward use-cases for software defined networking.

Below is an example of a packet filtering function implemented in Phyton that was tested using the POX controller and the Mininet SDN environment:

```
    def addRule(self, address, toAll=False,
dl_type=0x800, nw_proto=1):
policyAddRule = of.ofp_flow_mod()

if dl_type == 0x800:

ip_addr = IPAddr(address)

rule_group = (ip_addr, dl_type, nw_proto)

policyAddRule.match.dl_type = dl_type

policyAddRule.match.nw_dst = ip_addr

policyAddRule.match.nw_proto = nw_proto

policyAddRule.priority = 65535
```

Mininet creates a realistic virtual network, running real kernel, switch and application code, on a single machine (VM – Virtual Machine, Cloud or native), in seconds, with a single command.

Mininet allows simulation of SDN networks including controllers, switches and hosts.

Open vSwitch (OVS), which comes preinstalled on the Mininet VM, and this multilayer open switch implementation also offers support for OpenFlow protocol.

Mininet was used for testing and simulation of the policies implementation in a virtual network [5]. POX is a software platform that acts as SDN Controller, written in Python 2.7 that is communicating with elements that understand the Openflow 1.0 protocol [10].

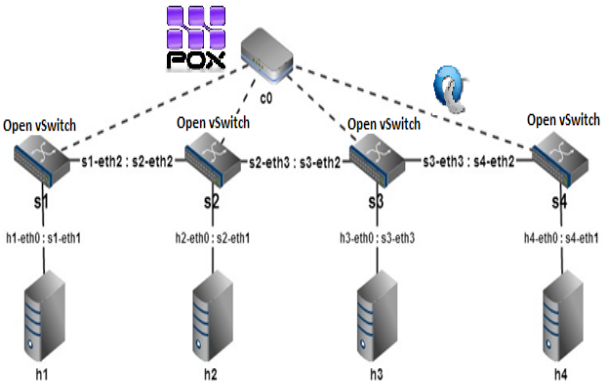

Fig. 3 The Mininet test environment based on POX SDN Controller and virtual switches

The implemented application does packet filtering based on implemented rules, but is exemplificative for the packet inspection capability of SDN. The main algorithm for stream discrimination implies the packet arrival, comparing information from the header with the policy rules described at controller level and applying the actions to the packet (modifications, forwarding or packet dropping). When a network element is connected to the network the event **ConnectionUp** is triggered, and the **start_policy(event)** from the **launch()** function creates a Policy object for every network connected element.The function **addRule(self, address, toAll=False, dl_type=0x800, nw_proto=1)** accepts 4 arguments, an address (IP or MAC), dl_type (dl_type=0x800 – type IP packet, dl_type= 0x806 – type ethernet) or protocol number (6 = TCP) and, if the argument toALL is True, than the rule is added on all policy elements in the network. An advantage of a SDN distributed policy function is that different rules could be applied on each equipment that understands the Openflow protocol by sending a message **ofp_flow_mod()** for flow modification (the Flow-table is updated).

4. ARCHITECTURE FOR POLICY FUNCTION IMPLEMENTATION USING ATCA

ATCA (Advanced Telecom and Computing Architecture [7]) represents a high-tech modern platform with a standard shelf and a back-plane ("mother-board") compliant with the regulations of PIGMG (PCI Industrial Computers Manufactures Group).

The modular ATCA platform can be configured to act as any element of the 3G or LTE core network, while there are already developed very compact implementations of the "LTE in a box"[12] concept, where all core network elements are implemented on the same ATCA chassis.

In our case, the available configuration, having the dedicated packet processing board and the computing board, is extremely suitable for a policy function implementation that includes, but not be limited, to the functions of a 3GPP LTE PCRF implementation.

These blades are particularly the following (see Figure 4): the FlexCore ATCA-FM40 – Ethernet switching boards, ATCA-XE80 computing boards, ATCA-PP50 – packet processing boards that will be responsible for flow discrimination and policy check.

The two packet processing blades (PP50) have each with two packet processors RMI-Netlogic-Broadcom – type XLR732 – that have a „super-scalar "architecture.

Each processor is multi-core MIPS64 ("without Interlocked Pipeline Stages") and each core can run 4 threads (than a total of 8 x 4 = 32 virtual cores/processor).

Fig. 4 The experimental configuration – front view of the installed ATCA 40G platform

All applications run on Linux virtual machines, while the data fast-path is operated by the RMI-OS. Operating Systems (OS) aren't recommended to run on a per thread basis, so they run on a per core basis, so the existing cores are split between Linux virtual machines, that run on N cores (N>1) and RMI-OS, running on 8-N cores, on top of an XLR "bootloader".

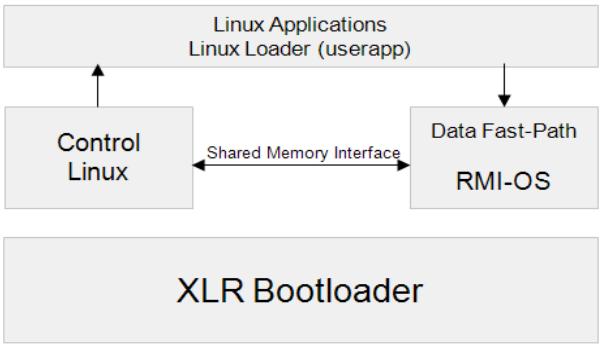

Fig. 5 Software configuration of the PP modules

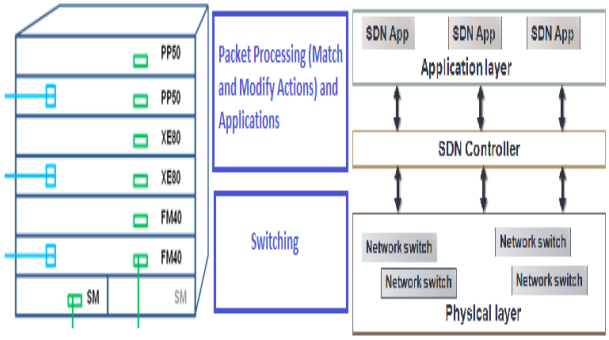

Fig. 6 Proposal of SDN functions implementation on the ATCA experimental configuration

Similar to the SDN logic where the data path is separated, the PP80 board functions are divided: in the Telecom use-cases, Linux could run control software (e.g. call control, bandwidth allocation, load balancing) while RMI-OS should manage packets analysis and discrimination (e.g. packet I/O via 10Gb "fast-path" interfaces).

The 8-N RMI-OS cores can communicate with the N Linux cores by a shared-memory interface. A more detailed description of the testing environment and the detailed commands used for synchronous operation of Linux virtual machines and RMI-OS was presented in [11].

In our case, the packet processing functions,

programmed at SDN controller level, could wrap the low-level functions of the packet processing board from ATCA and should communicate with databases and policy servers in order to take decisions.

Acting as the brains of the system, the policy controller tells the SDN controller how to route a specific flow, working closely with other elements in the service chain such as DPI, video optimization and firewalls.

CONCLUSIONS

Network Function Virtualization, though not yet standardized, is being already deployed by vendors that have launched different telco appliances running in virtualized environment.

This is the effect of the "as-a-Service" and Cloud influence that has a boom in IT area. Control-plane applications, such as policy servers, subscriber databases and IMS, will be among the first virtualized 4G core functions to be implemented in commercial mobile networks. These applications are already server-based and are relatively straightforward to port to a virtualized environment.

Because the concept of SDN was build based on flow-tables, including *match* and *modify action* triggers, so based on a native traffic discrimination, up to the layer 7 of OSI, the decision to implement policy enforcement functions using Software Defined Networks is ideal. At higher level, we demonstrated the possibility to implement traffic filtering based on a POX SDN Controller implementation, using Python programming language for the SDN controller (POX), and Mininet as SDN test environment. Policies were implemented at controller lever. At lower architectural level, the COTS hardware to implement the PCRF logic can be the standard ATCA platform, bringing the advantage of high processing power for DPI (the used ATCA platform has a dedicated board) and fast connections due the incorporated switching fabric. We were able to test packet processing elements at XLR processor level, using RMI-OS implementation and their communication with applications that reside in Linux virtual machines.

Being part of the same modular chassis, the packet processing, computing and switching blades have a great advantage, as the main components of an SDN network are clearly delimited: SDN controller functionality and flow analyze is done via packet processing, the computing blades take care of applications, while the data-forwarding plane is the role of the switching elements.

BIBLIOGRAPHY

1. Amdocs Whitepaper, *The Power of Policy- Enriching the data experience with advanced policy control* (2012)
2. Brown Gabriel, Heavy Reading, WhitePaper *Control Plane Elasticity & Virtualization in the 4G Core*, March 2013
3. ETSI NFV ISG (Industry Specification Group) – *Architectural Framework* http://www.etsi.org/deliver/etsi_gs/NFV/001_099/002/01.01.01_60/gs_NFV002v010101p.pdf
4. ETSI NFV ISG (Industry Specification Group) – *Usecases* http://www.etsi.org/deliver/etsi_gs/NFV/001_099/001/01.01.01_60/gs_NFV001v010101p.pdf
5. Feamster Nick, *Online Course, Software Defined Network*, https://www.coursera.org/course/sdn
6. Finnie Graham Heavy Reading, WhitePaper, *Policy Control & SDN: A Perfect Match?*, August 2013
7. Kuhlmann R. - *ATCA: Advanced Telecom Computing Architecture - Die Plattform der Zukunft für Telekommunikations-systeme* - Franzis Verlag GmbH, 2007 – ISBN 9-7837-7234-1298
8. Nadeau T., Gray K., *SDN – Software Defined Networks*, O'Reilly, 2013, ISBN: 978-1-449-34230-2
9. Natarajan, S. and Wale, K. (2009): *Implementing ATCA in LTE network serving gateway nodes*, Radisys Whitepaper

10. POX online documentation, https://openflow.stanford.edu/display/ONL/POX+Wiki

11. Sandu F., Costache C., Balan T.C. Balica A.N, *Packet Processing on an ATCA 40G Platform*, MACRO 2013- International Conference on Recent Achievements in Mechatronics, Automation, Computer Science and Robotics, Tg. Mures, 2013

12. Solucomp, *"LTE in a Box" solution based on ATCA*, available web at: http://www.solucomp.com/LTE_in_a_box.html

OPTIMISATION OF 798-05 DIESEL ENGINE PERFORMANCE USING WASTE-GATED TURBOCHARGER

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Abstract: *The engine which is the object of the research work is used on commercial and military vehicles such as DAC 8.120-FPEG and DAC 11.154-DFAE for transport of cargo, being known as 798-05. The paper studies the increase of performance for heavy duty turbocharged diesel engines when the series type turbocharger is replaced with a waste-gated turbocharger. There were presented dynamometric tests performed on the facilities of Road Vehicle Institute Brasov - Romania, being evaluated engine performance parameters such as rated power, torque, specific consumption and smoke level on the speed characteristic at total load. It is emphasized the influence of intake manifold pressure variation which changes the profile of torque curve, improving the dynamic behavior and the environmental impact.*

Key words: *diesel engine, waste-gated turbocharger, visible pollutant emissions.*

1. INTRODUCTION

A classic method of energy harvesting in internal combustion engines is the turbocharging which turns a part of exhaust gas energy into mechanical work in the air charge compressor.

The mass of air intake in each cycle is increased and a higher fuel mass can be injected, thus producing a higher power at the same displacement, in other words, a higher power per unit of displacement.

The most compact and efficient turbocharger solution is made of a centripetal rotor gas turbine and a centrifugal compressor.

The turbocharger operation is, in a certain extent, self-adjustable as the lowering of speed or load reduces the energy of exhaust gas and, consequently, the compressor work and air flow rate.

In spite of energy benefits, there are also some drawbacks as turbocharger operation is not satisfactory along all the range of speeds.

The paper presents a research work performed to improve engine-turbocharger compatibility for the diesel engine 798-05 manufactured by Roman Truck Company of Brasov – Romania.

The engines of the series, with different ratings, were used on commercial and military vehicles (DAC 8.120-FPEG and DAC 11.154-DFAE, medium all-terrain unarmored cabovers for transport of cargo [4]).

The practical objectives of the work were to improve dynamic engine performance at low speeds and to meet the visible pollutant standards.

2. THEORETICAL APPROACH

For turbocharged engines operating at low speeds, the air flow rate delivered by the compressor is lower than the engine requirement and fuel combustion is incomplete, producing high emission of visible pollutants which, in lay terms, are called black smoke.

A partial solution to heavy smoke is the use of a device mounted on the mechanical in-line injection pump which limits the quantity of injected fuel in function of available air flow rate.

The device, known as LDA (abbre-viation of German term Ladedruck-abhängigkeit) regulates the injected fuel flow rate according to the charge air pressure [1, 3].

The design of diesel engines for vehicle propulsion should take into account two dynamic indicators [2]. The adaptability indicator, σ_M, measures the variation of engine torque with speed, expressing the engine capacity to overcome rolling resistance and aerodynamic drag:

$$\sigma_M = \frac{M_{\max}}{M_P} \quad (1)$$

with - $M_{\max}$ - maximum effective torque;

- M_P - rated effective torque.

The higher the values of σ_M, the higher is the engine capacity to overcome vehicle propulsion resistances.

The elasticity indicator, σ_n, measures the vehicle maneuverability in terms of gear shifting:

$$\sigma_n = \frac{n_P}{n_{M_{\max}}} \quad (2)$$

with n_P - rated speed;

$n_{M_{\max}}$ - maximum torque speed.

The higher the values of σ_n, the lower is the need for gear shifting.

The use of the LDA device is not favorable for the two indicators, as it reduces the engine torque at low speeds and rises the speed at which maximum torque is reached.

The balance between engine and turbocharger was studied, one of the most acceptable solution for heavy duty engines being the use of waste-gate turbocharger.

The engine-turbocharger operation can be explained according to figure 1, using the charge air pressure (p_s) variation reported to atmospheric pressure (p_0) versus engine speed. When the engine speed decreases, turbine speed decreases too, lowering the charge air pressure and air flow rate (curve no.2 in fig.1).

In this case, the fuel combustion is incomplete and engine exhaust emissions are increased.

Another solution can be a turbine having a higher ratio of expansion which can transmit more energy to the compressor and rise its speed, pressure and air flow rate (curve no.1 in fig.1).

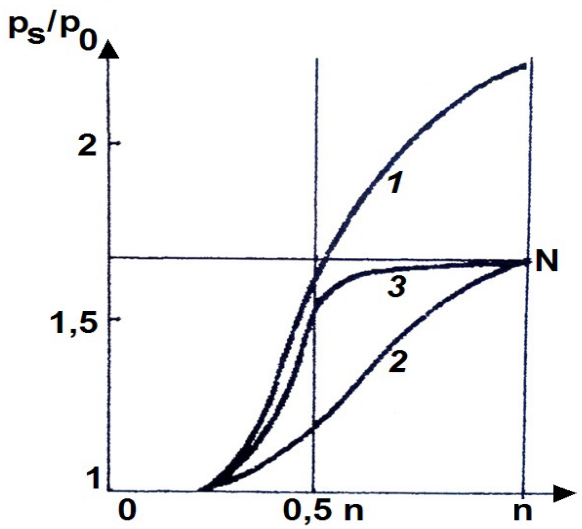

Fig.1 Profiles of pressure rise versus speed

The drawback in this situation is that at rated engine speed, the turbine speed is exceeding the reliability limit, the risk of failure being huge.

The optimum behavior is represented by curve no.3 which can be obtained using a by-pass system (waste-gate) which deviates a share of exhaust gas flow rate outside the turbine.

The exhaust gas deviation is done using a by-pass valve which is controlled by the charge air pressure in compressor which is proportional to the turbine speed.

The static pressure is taken over from the compressor casing which is transmitted pneumatically to the by-pass valve, which deviates more or less exhaust gas.

3. ENGINE TESTING

The engine subjected to testing was of the type 798-05, having the serial number 3702, with the main characteristics described in table 1. Preliminary measurement of charge air pressure indicated that the series turbocharger has a curve no. 2 characteristic, explaining the unsatisfactory results in terms of smoke emissions.

The following testing indicates the comparative behavior of the same engine, fitted with the series turbocharger (H1S-6780G H15A5) and waste-gated turbocharger (HB1C 6780G H07A5), both manufactured at Hidromecanica Brasov.

Table 1. Engine characteristics [7]

Engine type	4-stroke, direct injection
Cylinder configuration	6-cylinder, in line
Bore x Stroke [mm]	102 x112
Displacement [L]	5.5
Compression ratio	17:1
Rated power [kW]	88
Rated speed [rpm]	2500
Max. torque [N·m]	364
Max. torque speed [rpm]	1800

The engine was mounted on a dynamometric test bench of 300 kW, type MEZ-VSETIN at Road Vehicle Institute Brasov (INAR) [7], being instrumented with specific sensors of temperature (air, cooling liquid, oil and exhaust gas), pressure (atmospheric, oil and charge air), mass flow rates (air, fuel) and speeds. During testing the ambient temperature was 15°C and the atmospheric pressure was 720 mm Hg. The tests were performed according to Romanian engine testing standard [5].

The engine had the following auxiliaries:

- 6 blade cooling fan Φ 530x80 mm;
- no compressor and unloaded alternator.

The smoke emission was measured with a Hartridge MK3 opacimeter which has the effective length of measurement tube of 430 mm, the smoke indicator displayed being either HSU (Hartridge Smoke Units) or the coefficient of light extinction (m^{-1}).

At rated power, the air intake system indicated 170 mm column H_2O pressure loss and at the exhaust system 470 mm column H_2O , meeting the product specification. The engine tests included the plotting of engine speed characteristics at total load (power, torque, specific fuel consumption, smoke emission and charge air pressure).

4. INTERPRETATION OF RESULTS

The quality of the turbocharging can be evaluated using air charge pressure as illustrated in fig.2.

It can be noticed a constant increase of pressure for the waste-gated turbocharger.

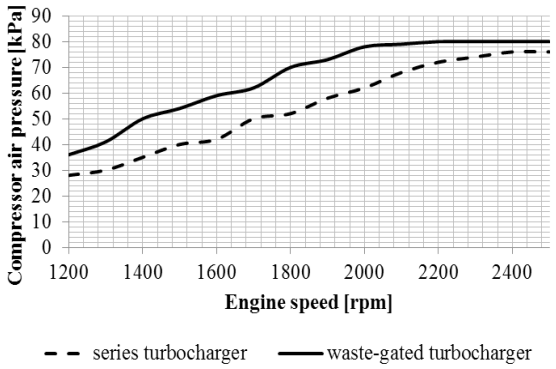

Fig.2 Air charge pressure versus speed

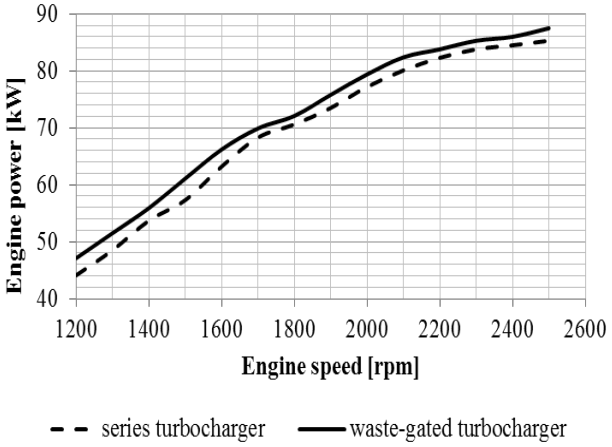

Fig.3 Rated power versus speed

Waste-gate turbocharging increases constantly the power with 2.5-5 kW on the whole range of speeds as can be seen in fig.3.

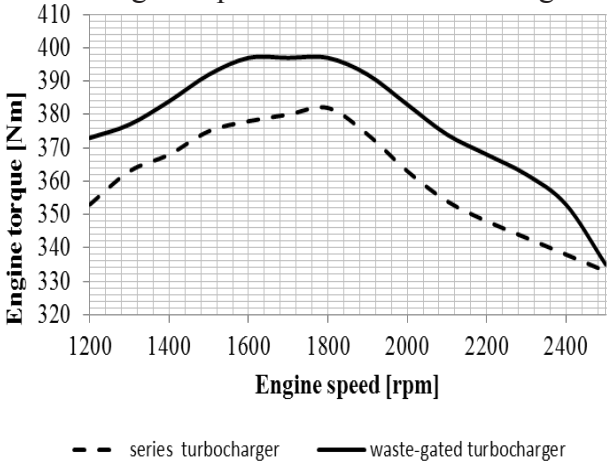

Fig.4 Engine torque versus speed

In figure 4 it can be observed a shift of $n_{M_{max}}$ from 1800 rpm to 1600 rpm which improves the dynamic indicators: the adaptability coefficient, σ_M , rises from 1.14 (series) to 1.18 (waste-gated), proving that the vehicle fitted

with waste-gated turbocharger will overcome better the propulsion resistances; the elasticity coefficient, σ_n, rises from 1.39 (series) to 1.56 (waste-gated), showing a lower need for gear shifting.

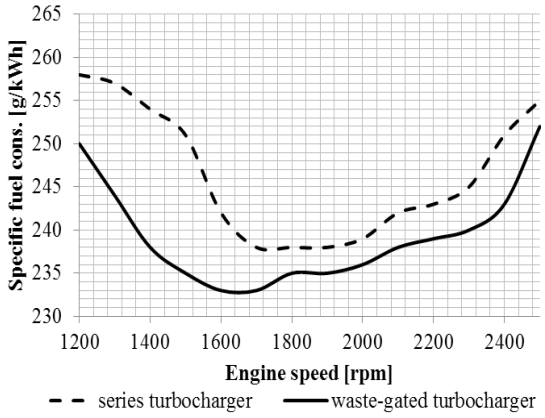

Fig.5 Specific fuel consumptions

In terms of energy economy, figure 5 illustrates that waste-gated solution is more advantageous, the energy contained in the fuel is better used resulting lower specific fuel consumption along the speed range.

The visible pollutants, as limited in ECE R 24.03 regulation [6], can be seen in fig.6, in red line.

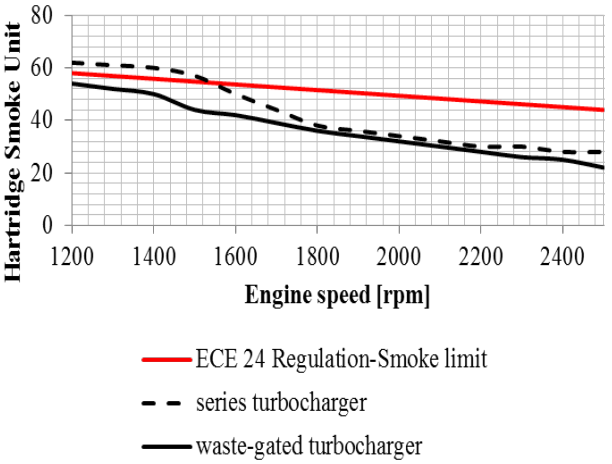

Fig.6 Smoke emissions versus speed

At lower speeds, the smoke is higher than the limit for the series turbocharger, but it lowers under the limit for the waste-gated version.

CONCLUSIONS

The waste-gated turbocharger demonstrated in average 3.5 kW higher rated power (3.3%), 16.3 N·m higher maximum torque (4.5%) and 7.1 g/kWh (2.9%) specific fuel consumption lower than series turbocharged version. It also revealed improved dynamic indicators, as well as the compliance with visible emission standard ECE R24.03 on the whole range of speeds.

BIBLIOGRAPHY

1. Challen, B., Bărănescu, R.(ed.). *Diesel Engine Reference Book,* Oxford, Butterworth-Heinemann, (1999).

2. Grunwald, B., *Teoria, calculul si constructia motoarelor pentru autovehicule rutiere*. Bucuresti, Editura Tehnică, (1980).

3. Mollenhauer, K., *Handbook Dieselmotoren,* Berlin, Springer Verlag, (1997).

4. www.automobileromanesti.ro/Roman/

(Accessed: October 2014).

5. *** STAS 6635-87: *Internal combustion engines for motor vehicles. Rules and methods for bench testing.*

6. *** ECE-R 24.03, *Uniform provisions concerning the approval of the compression ignition engines with regard to the visible pollutant emissions of the engine.*

7. *** *Improving functional and reliability performance of 798-05 engine*, Study no.33525, Road Vehicle Institute, Brasov – Romania

DETERMINE THE PARAMETERS OF THE BRAKING CAPACITY OF THE SPECIAL VEHICLES BRAKING SYSTEMS

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Abstract: *This paper shows parameters that characterize braking motors vehicles, the deceleration, the braking space and the braking time, and the method of their determination. The technical condition of the assembly of the braking system components is a determining factor that can influence driving safely and affects, to an extent decisive, the addition of value to performance speed and acceleration of the vehicle. The importance of the characteristics of the braking system is derived from the active handling mode of the vehicle.*

Keywords: *braking system, deceleration, braking space, braking time.*

1. INTRODUCTION

Special vehicles on wheels appeared as a necessity to bring them into objective compliance to fight in accordance with the conditions to complete the portions of the unarranged fields, with high speed, use of a vehicle for military purposes revolutionizing land forces mobility.

For the proper conduct of the special vehicles mission in rough terrain, we are talking about, on one hand, the importance of the possibility of immobilization and retaining position and, on the other hand, during the braking process, the importance movement stability and reversibility or reversibility, to an encounter with an obstacle.

In view of the permanent trends of producers of motor vehicles to increase the dynamic quality for their models of machines, as well as congestion and increased unwanted events of the traffic it can be noted the value of braking system, as a critical component that can influence the increasing of the value of indices of operation of power – driven vehicles.

The importance of the characteristics of the braking system is derived from the handling active mode of the vehicle and offers the possibility of change in velocity and acceleration, during operation.

The kinetic energy gained by the motor vehicle, for the maintenance of the braking system operated shall be converted, on the one hand, to calorific energy by friction - energy which is then dissipated into the environment, and on the other hand are consumed in order to overcome rolling resistance and air which are always opposing the movement of the vehicle.

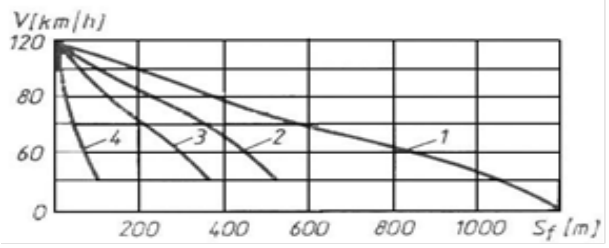

Fig.1 The dependence of the vehicle braking space towards the braking process. – after Frățilă Gh. (1986)

Figure 1 shows space dependence of the braking function of the car's braking process. In case no car brakes are used, the amount of space off (curve 1) is conditional on rolling resistance and air resistance, as well as the mechanical losses in the transmission. As a result, the forces have little effect especially at moderate speeds.

If the engine does not disengage, running resistances increase (on account drag torque of the engine), and the space travelled up to the halt of the vehicle shall be greatly reduced (curve 2).

The braking effect increases even more, if the engine is forced to operate as a compressor, by blocking the exhaust pipe before the muffler (curve 3). If the vehicle's brakes are used, the amount of space to a stop shall be reduced very much (curve 4).

The braking devices must meet a number of conditions constructive and functional for the purpose of ensuring the braking capabilities of the vehicle as well as to be able to implement the performance value speed and acceleration safely.

2. BRAKING CAPABILITY PARAMETERS

The parameters that characterize vehicles braking systems are deceleration, the braking space and the braking time. Layout forces and moments acting on the car in the braking process [3], in the general case, are shown in figure 2.

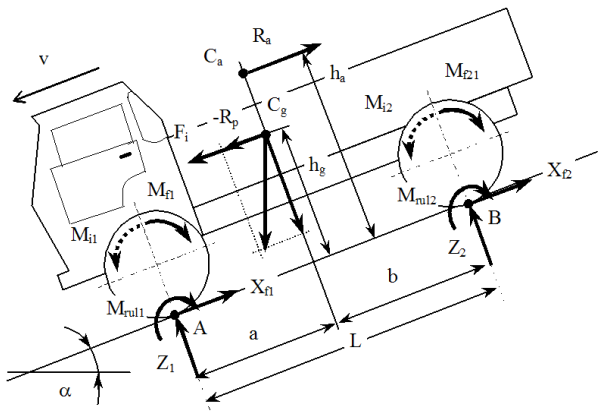

Fig. 2 Layout forces and moments acting on a power – driven vehicle braked – after Marinescu M. (2000).

C_g- the center of gravity; C_a- the center of pressure; R_a- air resistance; $(-R_p)$-„grade resistance" on a slope; F_i- inertia force; G_a- vehicle weight; h_g- the height of the center of gravity; h_a- the height of the center of pressure; a, b- distances front/rear from the center of gravity to the support points of the wheels, and wheelbase; L-wheelbase; α- gradient angle; $M_{i1,2}$- moments of inertia of the wheels; $M_{f1,2}$- moments of braking applied wheels; $M_{rul1,2}$- moments of rolling resistance; $Z_{1,2}$- the roadway reactions; $X_{f1,2}$- tangential braking reactions.

In fig 2, air resistance has the known expression: $R_a = kAv^2$, in which A represents the front surface area, k is the coefficient of resistance of the air, and v is the speed [m/s].

Also, the inertia force is given by $F_i = \frac{G_a}{g}\frac{\mathrm{d}v}{\mathrm{d}t}$, where $\frac{\mathrm{d}v}{\mathrm{d}t}$ is the deceleration and grade resistance $R_p = G_a \sin\alpha$, is in fact, a driving force, because the vehicle goes down on a slope. Taking into consideration the forces of inertia, it is possible to apply the principle of d' Alembert. Thus, from the balance in the direction of movement, after the replacements, results:

$$\frac{G_a}{g}\frac{\mathrm{d}v}{\mathrm{d}t} = X_{f1} + X_{f2} \mp G_a \sin\alpha + kAv^2$$

2.1 Determination of deceleration. The easiest way to determine it is the experimental way.

In the case of four – wheel braking, maximum deceleration is obtained when all wheels are transmitted simultaneously at adhesion limit, in which case the tangential reactions expressions will be: $X_{f1} = \varphi Z_{1\varphi}$, and $X_{f2} = \varphi Z_{2\varphi}$, where the two normal reactions are limited of adhesion.

From the equation the projection of forces normal to the direction of movement (fig.2), the following relationship shall be obtained:

$$\left(X_{f1} + X_{f2}\right)\Big|_{\max} = \varphi\left(Z_{1\varphi} + Z_{2\varphi}\right) = \varphi G_a \cos\alpha$$

providing maximum deceleration value in the general case:

$$\left.\frac{\mathrm{d}v}{\mathrm{d}t}\right|_{\max} = g\left(\varphi\cos\alpha \mp \sin\alpha + \frac{kAv^2}{G_a}\right)[\mathrm{m/s^2}]$$

or neglecting air resistance movement on level ground:

$$\left.\frac{\mathrm{d}v}{\mathrm{d}t}\right|_{\max} = g\varphi\,[\mathrm{m/s^2}]$$

In the case of the wheel braking only front axle, maximum deceleration is obtained for $X_{f1} = \varphi Z_{1\varphi}$, and the disappointed tangential to rear wheels will be $X_{f2} = \not{Z}_2 - \frac{2I_{r2}}{r_r^2}\frac{\mathrm{d}v}{\mathrm{d}t}$.

In accordance with motor vehicle dynamics, exclusive use of brake front axle wheel, normal reactions dynamic will be provided by:

$$Z_{1\varphi} = \frac{\frac{b}{L}}{1-\varphi\frac{h_g}{L}}G_a\cos\alpha\text{, and}$$

$$Z_2 = \frac{\frac{a}{L}-\varphi\frac{h_g}{L}}{1-\varphi\frac{h_g}{L}}G_a\cos\alpha,$$

with that if it will calculate maximum deceleration, with the provision that the term

$$\frac{g}{G_a}\frac{2I_{r2}}{r_r^2} < 1,$$

and rolling resistance is negligible in relation to the other forces will be obtained for maximum deceleration in this situation of operation:

$$\left.\frac{\mathrm{d}v}{\mathrm{d}t}\right|_{\max} = g\left(\varphi\frac{\frac{b}{L}}{1-\varphi\frac{h_g}{L}}\cos\alpha \mp \sin\alpha + \frac{kAv^2}{G_a}\right)$$

or neglecting air resistance, when traveling on level ground:

$$\left.\frac{\mathrm{d}v}{\mathrm{d}t}\right|_{\max} = g\varphi\frac{\frac{b}{L}}{1-\varphi\frac{h_g}{L}}[\mathrm{m/s^2}]$$

In the case of braking only on the rear axle wheels, maximum deceleration is obtained for

$X_{f2} = \varphi Z_{2\varphi}$, and $X_{f1} = \not{Z}_1 - \frac{2I_{r1}}{r_r^2}\frac{\mathrm{d}v}{\mathrm{d}t}$,

in which case normal reactions expressions are:

$$Z_1 = \frac{\frac{b}{L}+\varphi\frac{h_g}{L}}{1+\varphi\frac{h_g}{L}}G_a\cos\alpha\text{, and}$$

$$Z_{2\varphi} = \frac{\frac{a}{L}}{1+\varphi\frac{h_g}{L}}G_a\cos\alpha.$$

Neglecting also, $\frac{g}{G_a}\frac{2I_{r2}}{r_r^2} < 1$,

air resistance and rolling resistance is obtained when traveling on a slope:

$$\left.\frac{\mathrm{d}v}{\mathrm{d}t}\right|_{\max} = g\left(\varphi\frac{\frac{a}{L}}{1+\varphi\frac{h_g}{L}}\cos\alpha \mp \sin\alpha\right)$$

or on the roar surface:

$$\left.\frac{\mathrm{d}v}{\mathrm{d}t}\right|_{\max} = g\varphi\frac{\frac{a}{L}}{1+\varphi\frac{h_g}{L}}[\mathrm{m/s^2}]$$

It should be noted that in all the variants previously been treated decelerations are obtained from maximum braking without locking the wheels, because after locking, the value of adhesion and therefore the size of the

braking force developed are to be reduced by reducing coefficient of adhesion due to slipping.

If braking with all wheels (like in the case of normal operation) hypothesis allowed requires that the braking force to be distributed among the axels at the same ratio as well as axel loads.

As the hypothesis said they suppose braking at adhesion limit it doesn't matter if braking will be done with or without engine disconnected from transmission or it is used in conjunction any retarder.

2.2 Determination of the braking area. The braking space determines directly the braking qualities of a motor vehicle, being in close liaison with road safety.

For determining the relationship of the calculation of the braking space we start from the definition of deceleration, which may be written in the form $\frac{\mathrm{d}v}{\mathrm{d}t} = \frac{\mathrm{d}v}{\mathrm{d}S_f} \cdot \frac{\mathrm{d}S_f}{\mathrm{d}t} = \frac{\mathrm{d}v}{\mathrm{d}S_f} v$, from where it results the elementary braking space S_f.

Using previous relationship and considering that speed varies during braking from v_1 to v_2, the relationship for the calculation of the braking space is:

$$S_f = \frac{1}{g}\int_{v_2}^{v_1} \frac{v\mathrm{d}v}{\frac{X_{f1}+X_{f2}}{G_a} \mp \sin\alpha + \frac{kAv^2}{G_a}}$$

Making assumption that braking is done at adhesion limit on all of the wheels and considering the tangential braking reactions X_{f1} and X_{f2} are constant, at the same time neglecting air resistance, previous relationship becomes:

$$S_f = \frac{1}{g}\int_{v_2}^{v_1} \frac{v\mathrm{d}v}{\frac{X_{f1}+X_{f2}}{G_a} \mp \sin\alpha} = \frac{v_1^2 - v_2^2}{2g\left(\frac{X_{f1}+X_{f2}}{G_a} \mp \sin\alpha\right)}$$

and therefore minimum braking space becomes (for X_{f1} and X_{f2} with maximum values):

$$S_{f\min} = \frac{v_1^2 - v_2^2}{2g(\varphi\cos\alpha \mp \sin\alpha)}$$

and, in the case braking to a stop on a level road:

$$S_{f\min} = \frac{v_1^2}{2g\varphi},$$

from where it can be seen that the space of braking is in directly proportion to the square of the speed at which braking starts and inversely proportional to the value of the coefficient of adhesion.

2.3 Determination of the braking time. The braking time is of importance especially in the analysis of work processes of the braking device [1], and it is less used in appraising braking capability.

To establish relationships for the calculation of the braking time we start from the expressions of the braking vehicle movement equation or deceleration.

$$T_f = \frac{\delta}{3{,}6g}\int_{v2}^{v1} \frac{\mathrm{d}v}{\gamma_f + \psi + \frac{v^2 k A}{3\,G_a}} \text{ [s]}$$

in case we consider $\gamma_t = const$ and we neglect air resistance:

$$T_{f\min p} = \frac{1}{3{,}6g}\frac{v_1 - v_2}{\varphi\cos\alpha \mp \sin\alpha} \text{ [s]}$$

and, in the case braking to a stop on a level road $T_{f\min p} = \frac{v_1}{3{,}6g\varphi}$

2.3 Vehicle braking diagram. Analysis of the braking process and determine the parameters of the braking capacity has been made on the assumption that the braking system of the motor vehicle shall enter into action instantly and develop maximum braking force to a certain value of the power of the pedal.

In fact, from the moment in which there is a need braking and to peak deceleration a certain period of time must pass, determined by driver and braking system response of the motor vehicle. This is highlighted in Fig. 3.

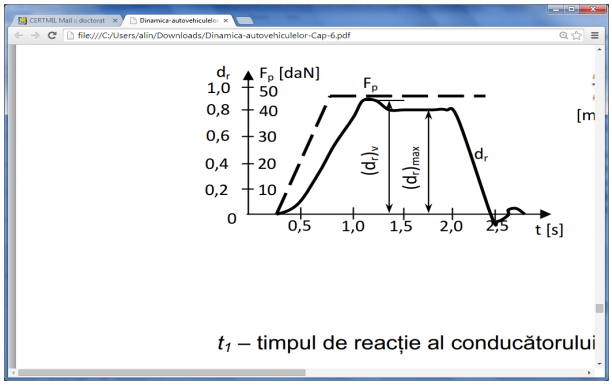

Fig. 3 – real chart of the braking of a vehicle – after Fratila Gh. (1986)

F_p- force of the pedal, d_r- the deceleration, d_{rv}- the peak value of deceleration, d_{rmax}- the maximum value of the deceleration.

CONCLUSIONS

Because of the significant role that the braking installation has to ensure the safety of movement, it is essential that it has a close to 100% reliability. To meet this requirement a series of constructive measures were taken, in order to permit vehicle braking effectiveness sufficient in the event of the appearance of damage in a section of the braking device or warn in time the driver about an eminent reduction in efficacy.

For road obligatory safety minimum values shall be described for braking efficiency expressed as maximum length of the space of braking and the minimum amount of deceleration, which are to be maintained for the exploitation of motor vehicles. Thus, the braking installations for motor vehicles must comply with the following conditions:

- must be capable of certain deceleration imposed, and braking is progressive, shock – free with maintaining stability of vehicle during braking, which shall, in particular, ensure the correct distribution of the braking effort to decks;

- not to require a higher effort from the driver, and braking shall be provided solely to driver's intervention; they must not be possible to engage concomitant of the brake pedal and accelerator pedal;

- conservation qualities of the braking vehicles in all working conditions encountered in service in all situations of use; to provide heat discharge which shall arise during braking;

- adjustment of the clearances to make themselves as less often and convenient or even in automatic mode; walking up and running quickly, and the braking force to act in both directions of movement of vehicle;

- braking should not be influenced by uneven road surface (due to the vertical movement of the wheel) and turning the steering wheel and have quiet operation;

- to allow motor vehicle immobilized on a slope in the case of a de facto ally of long direction;

- it must be designed, constructed and installed in such a way as to resist corrosion phenomena and aging to which they are exposed;

- not to allow oil and dirt to enter at the friction surfaces;

- to have a simple construction and a low cost.

ACKNOWLEDGMENT

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BIBLIOGRAPHY

1. Frăţilă, Gh., Mărculescu, Gh., *The braking systems of motor vehicles*. Bucharest: Technical Publishing House (1986).
2. Ghiulai, C., Vasiliu, Ch., *Motor vehicle dynamics*. Bucharest: Didactical and Pedagogical Publishing House (1975).
3. Marinescu, M., *Modern Solutions in Vehicle Manufacturing*. Military Technical Academy Publishing House (2002 - in Romanian).
4. Untaru, M., ş.a., *The calculation and construction of motor vehicles*. Bucharest: Didactical and Pedagogical Publishing House (1974).
5. Untaru, M., ş.a., *The dynamic of motor vehicles on wheels*. Bucharest: Didactical and Pedagogical Publishing House (1981).

MULTI AERIAL SYSTEM STABILIZED IN ALTITUDE FOR INFORMATION MANAGEMENT

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Abstract *: Multi agent Aerial system for information management, acronym MASIM aims acquisition of spatial information in areas of interest, refining and managing the data obtained using* ***a*** *multi agent miniaturized platform, coordinated by a mobile off-road earth station.*

Key words*: MASIM, radio altimeter, saturation.*

1. INTRODUCTION

Multi agent systems are a complex area because it consists of several functional levels: lower level (with data collection based sensors, data fusion - combining data to reduce uncertainty, data for assessing the situation and threats); middle level (with agents who decide how to act effectively, to create a coordinated response); higher level (strategic planning that includes objectives and priorities to achieve response to several beneficiary structures).

MASIM is a decentralized architecture, which offers the advantage of robustness, scalability and versatility, built on a multidisciplinary approach:

- filtering and data fusion methods for estimating the relevant state variables (position of victims and rescue vehicles);
- decision-making and machine learning methods for determining the responses (when and where are the targeted intervention and evacuation vehicles);
- multi-agent systems, game theory and management mechanisms for modeling interactions between collective actors behavior;
- studies of various system architectures and topologies to exchange information (centralized, hierarchical or decentralized).

Mobile command center and network monitoring overflight is currently equipped with a solution for piloting the UAV equipment based on open-source architecture with web-based graphical targeting using manual choice points maps (like Google Earth).

The solution can run on mobile devices tablet / notebook to ensure mobility. This solution will be integrated in the database automatically and will transfer based scripts with optimal solution proposed in this project in order to simplify the UAV operator duty for manually entering overflight plan, eliminating any errors or increasing cost and saving time. (fig.1)

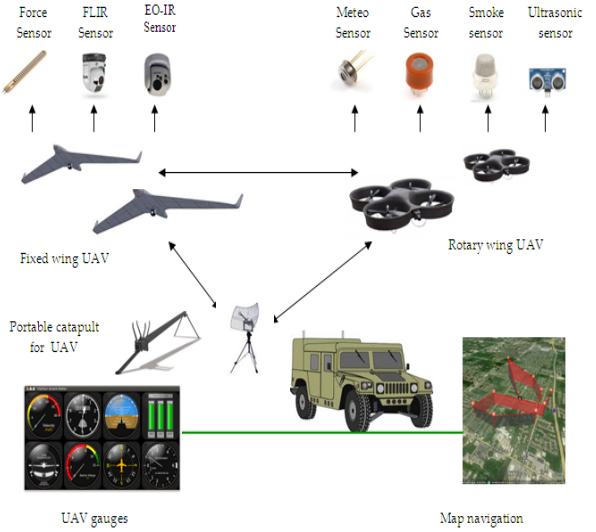

Fig.1 MASIM Concept

The portability level of the application implies the possibility of running an operating system dedicated to mobile devices with Java support (tablets or laptops).

Secondary features regarding the application are: configure various operational managers or users, configuring automatic data transmission format TXT / XML, archiving or restoring the database. The proposed solution for the MASIM system aims to implement fuzzy probabilistic algorithms to optimize an surveying area and network equipment necessary for UAV overflight in actions after a certain predetermined purpose and specific surface under certain conditions.[1,2,3]

Thus, once introduced into the application, specific patrol conditions - as input, for example, in the case of missing persons searches: size and shape of the surface; - Altitude overflight (depending on sensor performances optimal for this task); and pre-configured quality parameters that can be equipped with UAV sensors equipment (distance from that track, if they can detect day from night, etc.), the application will automatically run optimization algorithms, proposing one or many overflight solutions - as output data, depending on the purpose established: Radio altimeter provides accurate measurement of heights between 0–10000 m, flight range and corrective issue signals to the autopilot.

2. THE OPERATING PRINCIPLE OF THE RADIO ALTIMETER WITH FREQUENCY MODULATION

Passive radio altimeter works on the principle of determining the distance or altitude, based on the propagation of radio waves in a straight line at a constant speed and especially their ground reflection (fig ...) radio altimeter transmitter (EM) which generates radio waves which are radiated through the emission antenna towards the ground.

Electromagnetic wave reflected from the ground, is captured by the antenna AR and applied to receiver Rec.

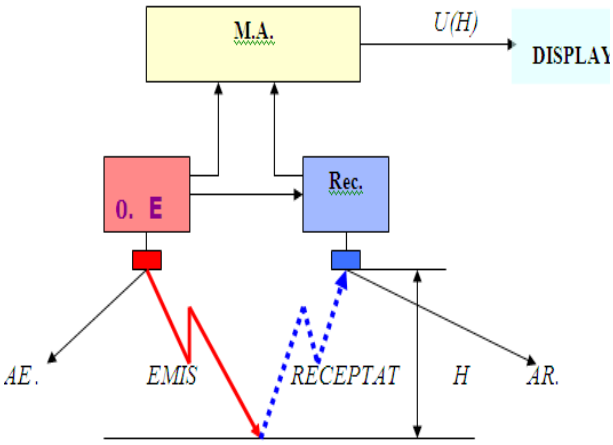

Fig. 2 Simplified block diagram of the radio altimeter MF

Altitude measurer generates voltage U(H) proportional to the time required for the electromagnetic wave to travel the distance H between the transmitting antenna and ground and ground to the receiving antenna, delay t_h =2H/c as a signal from the reception moment compared to the emission moment. On the other hand, delay τ=2H/c. Given the significance of sizes according to Figure 3.2., we can write:

$F_b=(2\Delta f/T_m)\times(H/c)$ (2.4)

$H=(F_{b\times}T\ c\ /2\Delta f)=F_b\times T\times c/2\Delta f$

$H=(c/2)\times(T_m/\Delta f)\times f_b$

$c/2 = ct.$ (1)

where: $T_m=ct.;\ \Delta f=ct.;\ H=KF_b$

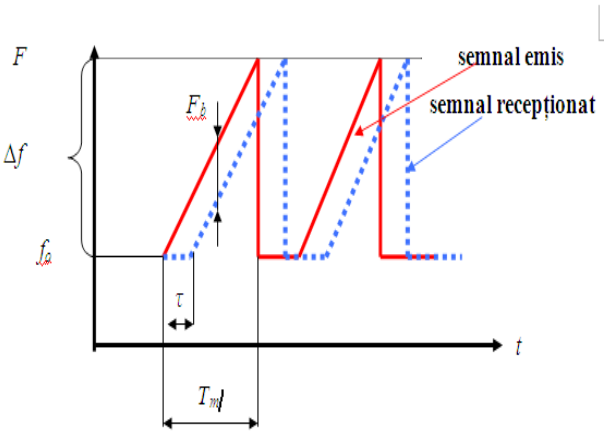

Fig. 3 Diagram regarding the operating principle of radio altimeter with frequency modulation

Frequency variation is kept fixed as Fb automatically maintained constant, resulting that Tm is proportional to the height H, the measurement period Tm is achieved by performing a conversion period - tension. Longitudinal control aims pitch angle, speed and altitude. This is achieved through three direct loops and two indirect.

Direct control loops depth, gauge and engine speed and indirect loops give direct orders.

Direct loops are the depth control, depending on the speed of rotation around the lateral axis (V_y); control the depth depending on the pitch angle; speed control (n) depending on the speed of flight.

Indirect loops: the depth control with altitude; depending on the depth control airspeed deduction [2,3,4].

3. THE CONTROL OF THE RADIO ALTIMETER

Item 1 is the UAV,control grouping is made by ψ, $\overset{\circ}{\psi}$ and command grouping by δ. Item 3 makes corrections some passive or active, and N is the static characteristic of the actuator. The achieved structure is considered the control of three state variables involving features and superior dynamic performance.[5,6]

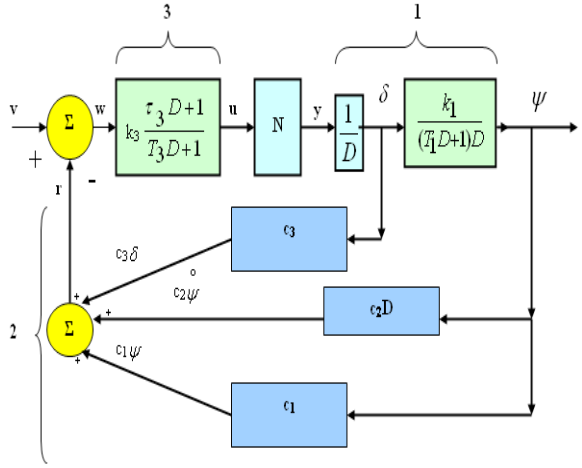

Fig.4 Command and control structures

In this architecture we have minimal state vector[6]:

$x_1 \cong r = c_1\psi + c_2\dot{\psi} + c_3\ddot{\psi}$

$$x_2 = \overset{\circ}{x_1} - c_2c_3T_1y \tag{2}$$

$$x_3 = \overset{\circ}{x_2} + T_1r-(k_1c_2+c_1c_3)y$$

We have the following operators:

$$H_1(D) = \frac{k_1}{(T_1-1)D^2}, \tag{3}$$

$$H_2(D) = c_1 + \left(c_2 + \frac{c_3}{k_1}\right)D + \frac{c_3T_1}{k_1}D^2, \tag{4}$$

$$H_2(D) = k_3\frac{\tau_3 D}{T_3D+1}, \ \tau_3 \neq T_3 . \tag{5}$$

State equations of the system

$$\overset{\circ}{x} = \mathbf{M}x + \mathbf{N}y + \mathbf{P}p + \mathbf{F}v,\ y = g(u) \tag{6}$$
$$u = \mathbf{N}^Tx + \mathbf{F}y + \mathbf{L}^Tp$$

which performs control after 3 state variables elements:

$$\mathbf{M} = \begin{bmatrix} -\frac{1}{T_1} & k_2 & 0 & 0 \\ 0 & 0 & \frac{1}{T_2} & 0 \\ 0 & 0 & 0 & 0 \\ -\frac{k_3\tau_3}{T_3^2}(k_3-1) & 0 & 0 & \frac{-1}{T_3} \end{bmatrix}, \tag{7}$$

$$\mathbf{N} = \begin{bmatrix} c_3 \\ \frac{k_1c_2}{T_1} \\ \frac{c_1k_1}{T_1} \\ 0 \end{bmatrix}, \tag{8}$$

$$\mathbf{P} = \begin{bmatrix} -\frac{k_3\tau_3}{T_3} \\ 0 \\ 1 \\ 0 \end{bmatrix}, \tag{9}$$

$$\mathbf{F} = \begin{bmatrix} 0 \\ 1 \\ 0 \\ \dfrac{k_3\tau_3}{T_3} \end{bmatrix}, \quad L = \frac{k_3\tau_3}{T_3}, \tag{10}$$

For linear systems, parallel-opposed correction by connections c_2 and c_3 of member 2 is similar to a serial correction of member 3 and has the following form :

$$H_{3e} = k_{3e}\frac{b_2D^2 + b_1D + b_0}{a_2D^2 + a_1D + a_0} \tag{11}$$

If nonlinearity N is replaced with a beam with uniform slope memory, equivalent operator $H_{3e}(D)$ has the following expression[6]:

$$H_{3e}(D) = \frac{(T_1D+1)D}{T_1D^2 + (1+c_3T_1)D + k_1c_2} \tag{12}$$

4.THE CONTROL AND THE REACTIONS TO MAINTAIN A STABLE CONSTANT ALTITUDE

Control system which adjusts the altitude for UAV created in SIMULINK and commanded from MATLAB. In Figure 5 we are introducing the controls and command model performed in MATLAB Simulink 2010.[5]

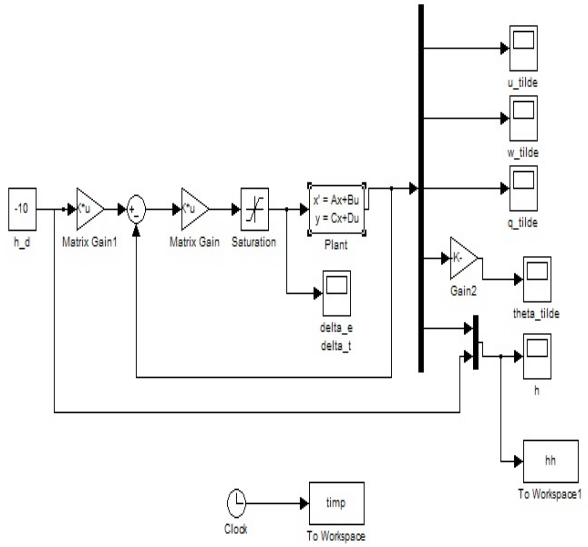

Fig. 5 Simulink model

We will study the reaction time to stabilize the radio altimeter command line on a 20-second interval.

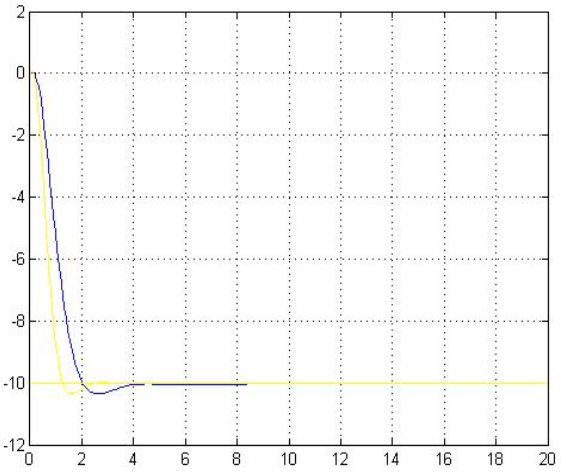

Fig.6 Saturation for a altitude of 100 meters

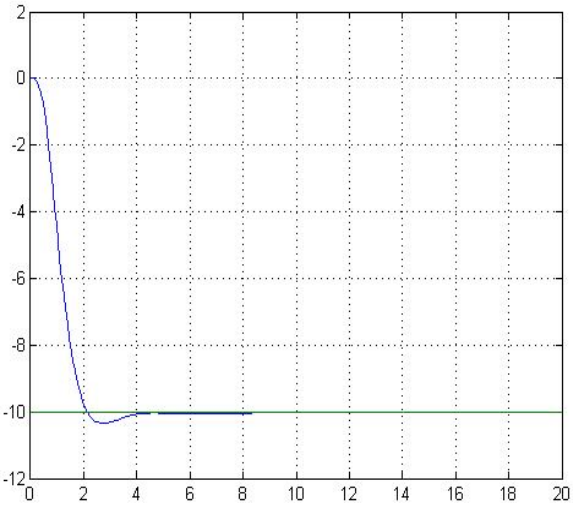

Fig.7 Saturation for a altitude of 1000 meters

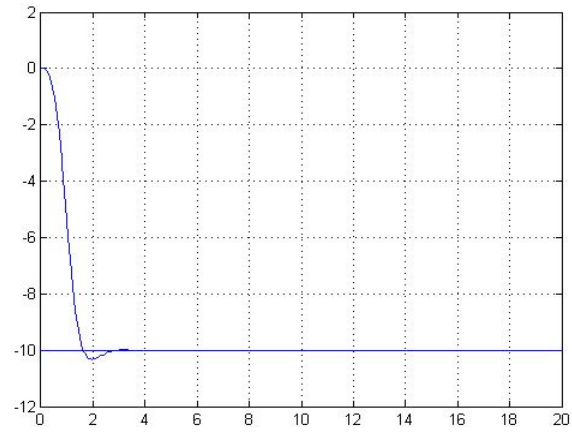

Fig.8 Saturation for a altitude of 10000 meters

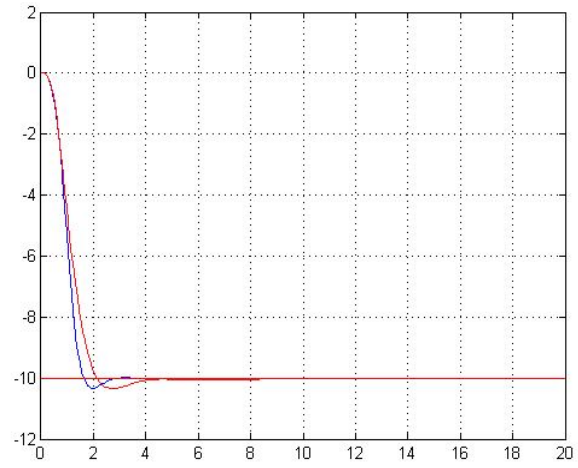

Fig.9 Constant negative saturation for a altitude of 100 meters

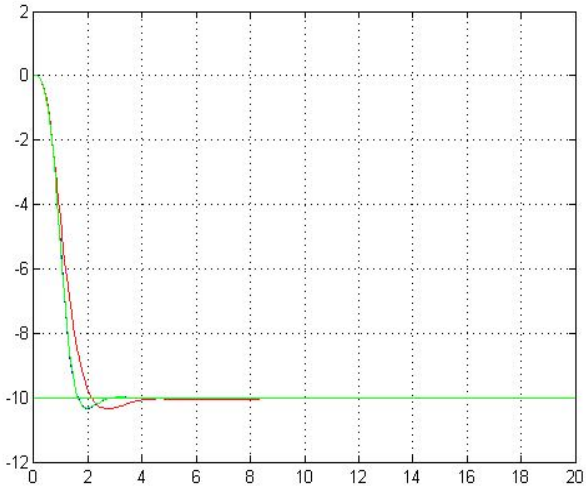

Fig.10 Constant negative saturation for a altitude of 1000 meters

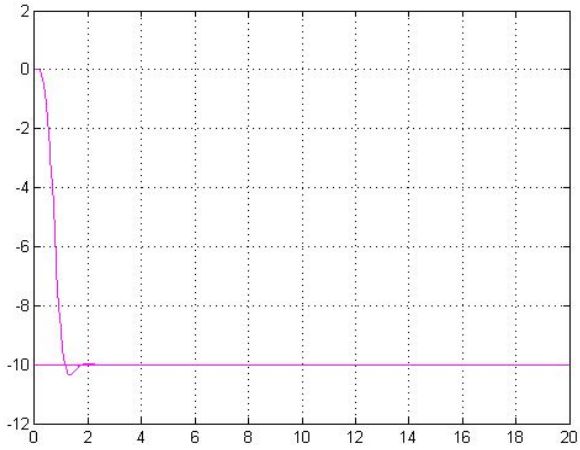

Fig.11 Constant negative saturation for a altitude of 10000 meters

We see on OX reaction time, which is set up to limit of 20 seconds and on OY axis command line it should be constant. As you can see this becomes constant after 4 seconds. Saturation values during the control limits the time until it becomes a constant (the courts). Increasing saturation limits, especially the negative ones (errors), the command line acts in a period of 2 seconds at 10,000 feet.

In the first chart we set an altitude of 100 meters, 2nd chart have an altitude of 1000 and the 3rd chart have an altitude of 10000 feet. The negative saturation was modified.

Starting at the chart 4 we kept the negative saturation values and increased the value of positive saturation at these altitudes: 100, 1000 and 10,000 meters (fig. 6,7,8,9,10,11).

CONCLUSIONS

Maintaining constant altitude flight is an important parameter for MASIM concept, this can be realized through radio electronic means.

Maintaining constant altitude require adjustments on the longitudinal flight: pitch angle and speed.

Positive saturation is 10 times smaller than the negative one, control error is small due to the fact that increased error space left for calculations will help correct the difference.

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"Multi Agent Aerial System with Mobile Ground Control Station for Information Management".

BIBLIOGRAPHY

1. UAS Yearbook, *Unmanned aircraft systems – The Global Perspective 2011/2012*, Blyenburg & Co, june 2011, Paris, ISSN 1967-1709, 216 p., www.uvs-info.com

2. Beguin B., Breitsamter C., Adams N, *Aerodynamic investigation of a morphing membrane wing*, AIAA Journal, vol.50, no.11, nov. 2012, p2588-2599.

3. Barbarino S., Bilgen O., Ajaj R.M., Friswell M.I., Inman D. J., *A review morphing aircraft*, Journal of intelligent material system and structures, vol 22, 2011, p823-877.

4. Melin T., Isikveren A. T., Friswell M.I., *Cost appreciation of morphing uav projects at a conceptual design stage*, 2008, p 6., http://michael.friswell.com/PDF_Files/C239.pdf, consultat 07.12.2012

5. Simulink basics tutorial, 26 p. http://faculty.uml.edu/pavitabile/22.457/UMICH_Simulink_Tutorial.pdf

6. Prisacariu V., Cîrciu I. *The analysis of the flying wing in morphing concept,* INCAS BULLETIN, Volume 5, Issue 2/ 2013.

ASPECTS REGARDING THE USING OF STOCHASTIC INGREDIENTS IN THE PROCESS OF ACCIDENTS MODELING – THE CASE OF SAFETY ENGINEERING SYSTEMS

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Abstract: *The analysis of factors contributing to accidents and the deep understanding of the correlations between these factors allows, on the one hand the emergence of building an explanatory framework of accidents occurrence, and highlights strategies and tactics to prevent possible incidents in the future. For the construction and implementation of safety systems one must consider all causative factors (direct and indirect) and the interrelationships between them. Specific mechanisms of accident patterns significantly affect the ability to identify and control hazards and thus prevent accidents. The results obtained by simulating the dynamics of costs and benefits, as a Wiener process with jumps modeled using Poisson distribution, is a complete solution for improving decision making in high technical systems.*

Keywords: *safety engineering systems, accident models, geometric Brownian motion, Poisson process*

1. INTRODUCTION

Understanding the mechanisms that contribute to accidents in complex socio-technical systems is extremely difficult due to complex interactions between component systems and processes dynamics.

In order to substantiate the occurrence of accidents explanatory framework that allows highlighting strategies and tactics to prevent possible incidents in the future an analysis of causal factors (direct and indirect) and the correlation between them is critical.

The analysis of the mechanisms of accidents occurrence in complex socio-technical systems in the context of complex interactions at the level of components can start from principles of systems engineering [1, 2] which provides an upper multiple perspectives and building upon the foundations of data and information specific to large and complex systems.

Sage highlighted the problem of scalability [3], Blauberg and Haimes evoked multidimensionality essential principle in understanding technical interactions with socio-human factors [4, 5].

Subsequent analyzes focused on a new discipline, namely safety engineering systems, beginning at the following generic hypotheses:

• impressive rate of technological change (which reduces the power of lessons learned, and introduces new elements of uncertainty);

• changing nature of incidents and accidents with the emergence of new types of hazards;

• reducing the ability of fructification of previous experience (by reducing capabilities and test periods);

• reduced tolerance for accidents in the context of more complex dynamics;

• the emergence of new difficulties in prioritizing the new aggressive and competitive backgrounds;

• the changing nature of the complex relationships between human factors and automation (resulting new types of human error related to inadequate human-machine communication);

• the dynamics of change and visions regarding safety regulations creates self sustainable imbalances.

2. MODELS OF ACCIDENT DEVELOPED USING SAFETY ENGINEERING SYSTEMS

One must first mention the existence of confusion about the concepts of safety and reliability.

In a context where most accidents arise from the interaction between system components and not the failure of individual components different situations should be taken into account: reliable, but insecure or unsure, but unreliable.

If reliability suggests an average lifetime between two failures, safety concerns the lack of accidents involving not necessarily the increase of the reliability of components and the increase of system security. In addition, socio-organizational levels fall to other levels different from physical systems [6].

Second, accidents are caused by chains of interdependent events and accident models should be designed not only to explain the causes of occurrence, but to offer prevention approaches.

In classical models a universal set of typical mechanisms is considered, which influences the results in the ability to identify and control hazards and thus prevent future accidents.

The first models in which integrated the socio-component were the domino management models [7], these management models are inadequate for complex socio- technological systems as they fail to identify human errors within accident processes.

Chain type models or multiple synchronized chains are based on safety engineering systems but suffer from problems of linear causality that can not be incorporated into the current highly non-linear phenomena, namely the difficulty selection and hierarchy of events that can be subjective.

The chains of events focus on past events, neglecting some relevant mechanisms.

The new models should provide an extended vision beyond causal factors that takes into account the conditions that allowed the appearance of the event or the indirect factors.

In multi-level approaches, Johnson proposed a model of systemic, contributory and direct factors such as the checklist method MORT (management oversight risk tree) [8] and Rasmussen-Svedung proposed a structure in which explicit social factors are detailed [9].

Assigning historical probabilities to PRA methods (probabilistic risk assessment) wrongly considered as mutually-exclusive events, does not describe the actual conditions in which the probabilities were assessed and thus they can not provide guidelines on the role of organizational and management factors [10].

Regarding the conflict between the flawed design and human errors the subjective temptation of overestimation of the role of the operator as the final element in the chain of events exist, including in interventions at limit of the functionality, alongside with the underestimation of the error of conception.

In order to provide a more accurate picture of the actions/decisions of the operator is essential to avoid the improvidence bias sites (to simplify the causality analysis by anchoring an initial hypothesis; overestimation of the role of rules/ procedures; superficial analysis of data relevance, over-correlation of results with previous actions) [11].

In the literature there is a tendency to treat errors of the human factor similar to physical fall of components/subsystems mechanisms, based on the simplistic idea of deviation from nominal specified or prescribed performance.

Approaches to the human factor are much more complex. Instructions and procedures are always on senso-stricto, as operators try to be more efficient and productive under the pressure of time. Thus, violation of rules shows some level of rationality [12].

The new mental models should include perceptions differentiation of designer - operator.

During development, the designers create their ideal model, significantly different from the real system built and used. The designer aims the integration of standard operators and this is actually the starting point in the development of work instructions and training programs or courses.

Moreover, the issue is complicated because there are differences due to structural diversity and evolution in time. The operator reference model starts from the model devised by the designer and seldom includes user experience.

Although formal procedures, work instructions and training are amended and updated periodically in order to reflect operating environment, there is always a delay. In addition, the operator is often working under time pressure and the productivity rules do not always reflect considered ideal procedures [13, 14].

Along with the maturation and evolution of the system, operators use feedback to update their mental models. Operators are involved in experimentation and learning processes in the borders of safety.

The experimentation is essential in change management and may lead to re-assess response to unexpected situations. As a result, designers' models are more simplistic than those of the operators, but usually all operators are liable even if the decisions were based on incorrect information processed reasonably at the time.

Feedback and experiments are essential elements in convergent mental models.

3. THE ANALYTICAL MODEL FOR ASSESSING THE SAFETY INVESTMENTS

Using the discrete time version of the geometric Brownian motion model allows the analysis of the accidents process and identifies management solutions leading to prevention disposals.

Multiple sources of risk jump are considered independent of each other, each having randomly size and jump timing (Poisson distribution) [15].

In designing a complex socio-technical system, each subsystem/component corresponds: direct costs (ie. acquisition, operation, maintenance, modernization, insurance), indirect or intangible costs (eg. giving up safety checks under efficiency and productivity pressure) and benefits (eg. reducing the number of accidents).

The current recognized value of the socio-technical system can be determined by the rate of increase/decrease expected in time related dependence assumptions and constant volatility (eq. 1).

$$\frac{dS}{S} = \mu \cdot dt + \sigma \cdot dz \tag{1}$$

In equation (1), S represents the value of the entire socio-technical system and is composed of and technical factor value S_1 and the human factor value S_2; $\mu_{1,2}(t)$ is the yield of each component in function of time, σ is the volatility, and z follows a Wiener process.

Consider the situation where S_2 (value of human resource insurance) accounts for 25% of the technical factor S_1 at time t_0 (eq. 2).

$$S = \sum_i S_i = 100 \quad \text{(monetary units)} \tag{2}$$

It exemplifies the following possible situations. For S_1, based on the models of reliability theory, it is considered a volatility of 20% per annum with -7% yield, and an initial value 80 monetary units. For S_2, based on theories of return on human factor is considered the volatility of 20% per year with 10% yield and an initial value 20 monetary units.

If ΔS_1 represents the fluctuation of the technical value and ΔS_2 is the fluctuation in the human factor in the next short period of time Δt, then equation (1) becomes (eq. 3):

$$\frac{\Delta S_1}{S_1} = -0{,}07\Delta t + 0{,}2\Delta z \tag{3}$$

$$\frac{\Delta S_2}{S_2} = 0{,}1\Delta t + 0{,}2\Delta z$$

The variable z follows a Wiener process, so Δz can be written as $\varepsilon\sqrt{\Delta t}$, where ε is a random variable with standard normal distribution. For a period of 30 days (Δt =1/12=0,083) equation (2) and (3) become (eq. 4):

$$\Delta S_1 = -0{,}00581 \cdot S_1 + 0{,}0576 \cdot S_1 \cdot \varepsilon_1 \tag{4}$$

$$\Delta S_2 = 0{,}0083 \cdot S_2 + 0{,}0576 \cdot S_2 \cdot \varepsilon_2$$

Using Monte Carlo simulation, values for the random variables ε_1 and ε_2 are generated using the inverse cumulative normal distribution. Thus, the evolution of the values of the two factors is obtained (figure 1a and 1b).

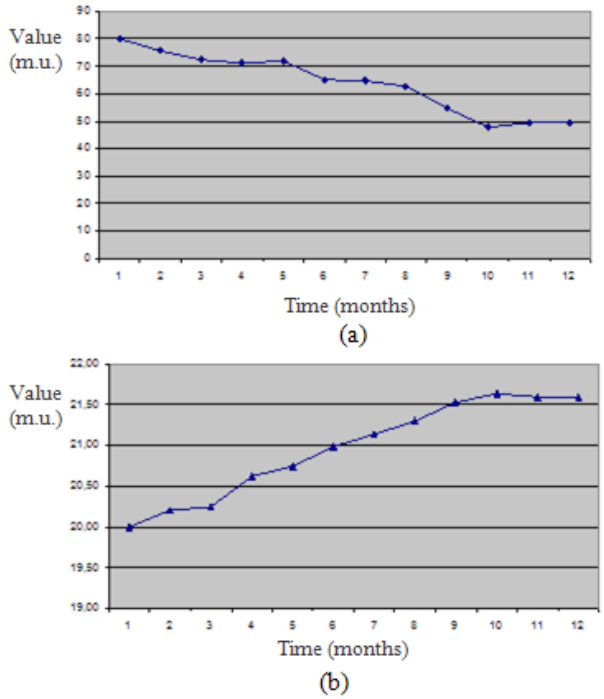

Fig. 1 Value of insurance
(a) Technical factor
(b) Human resource

Although there are limitations on the extension of these methods of calculation, management can not ignore the need to adapt to the new permanent organization of the market in order to remain competitive.

For the proposed model, evaluation of costs (C) is carried out on three components: insurance costs (C_a), maintenance costs (C_m) and acquisition, repair and upgrade (C_{aru}) (eq. 5).

$$C = C_a + C_m + C_{aru} \tag{5}$$

The insurance costs associated with technical and human factors are aggregated according to equation (6), where α_1 and α_2 are the insurance premium (figure 2).

$$C_a = \alpha_1 \cdot S_1 + \alpha_2 \cdot S_2 \tag{6}$$

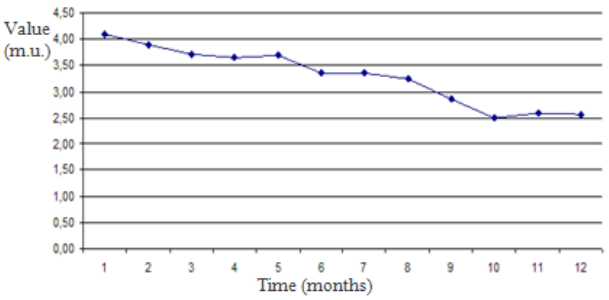

Fig. 2 The evolution of insurance costs

The costs of maintenance (corrective and adaptive) associated with regular work are determined by a similar algorithm with insurance costs to an initial value of 100 monetary units (maintenance costs are comparable in value to the cost of high-tech systems acquisition), which considers volatility of 20% per year with yield of 20% (figure 3).

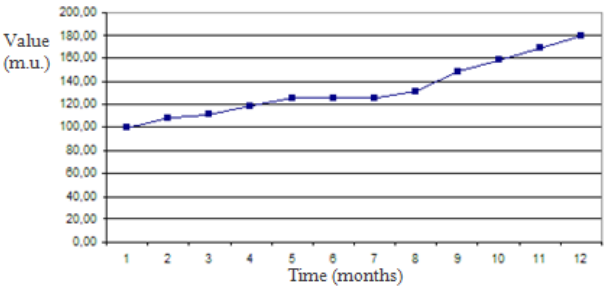

Fig. 3 The evolution of maintenance costs

Acquisition, repair and upgrade costs are evaluated in terms of the possibility of accidents. Positive jumps, whose source is the technical failures, are uncertainties about the timing and consequences of such events. The assessment of these costs with multiple risk sources (Brownian motion) and evolution described by a Markov chain is performed using equation (7).

$$C_{arm_{t+1}} = \eta \cdot C_{arm_t} + \sigma \cdot C_{arm_t} \cdot \xi \left[1 + \sum_{q=0}^{i} \left(e^{-\lambda} \frac{\lambda^q}{q!} \right) \right] \tag{7}$$

In the cost equation (7), η is the growth rate per unit time and is calculated based on yield μ, according to equation (8), σ is the volatility (standard deviation), ξ is a random number generated by using the standard normal distribution N(0,1), and q is the accident frequency.

Factor $\xi\left[1+\sum_{q=0}^{i}\left(e^{-\lambda}\frac{\lambda^q}{q!}\right)\right]$ represents the Wiener process that can affect the volatility σ (figure 4).

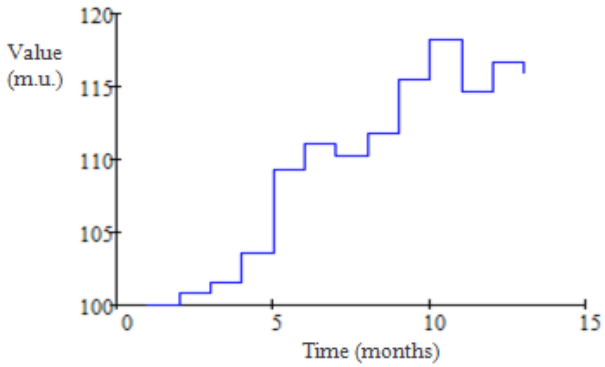

Fig. 4 The evolution of acquisition, repair and upgrade costs

This process was modeled using a Poisson distribution (specific for rare events), and the sum represent the discretization of the integral that characterizes continuous time processes.

$$\eta = 1 + \mu \qquad (8)$$

To assess the benefits (B) expressed by reducing the number of accidents due to investment in safety, we propose a model where, at the appearance of a jump, benefit changes with good operating system level probability p. The benefit equation is:

$$B_{t+1} = B_t\left[(1+p)+\sigma_1\cdot\xi\left[1+\sum_{q=0}^{i}\left(e^{-\lambda}\frac{\lambda^q}{q!}\right)\right]\right] \qquad (9)$$

In the benefit equation (9), σ is the volatility (in conjunction with human errors) and ξ is a random number generated using the standard normal distribution N(0,1).

Annual probability of accidents at the system level depends on the connecting elements and is determined by the mean time before failure (MTBF) rate.

The outcome of safety investment project is calculated based on the cumulative benefits and costs using Mathcad program (figure 5). The critical probability of producing accident (that involves total review of the resilience) is associated with time τ, when the benefits outweigh the costs.

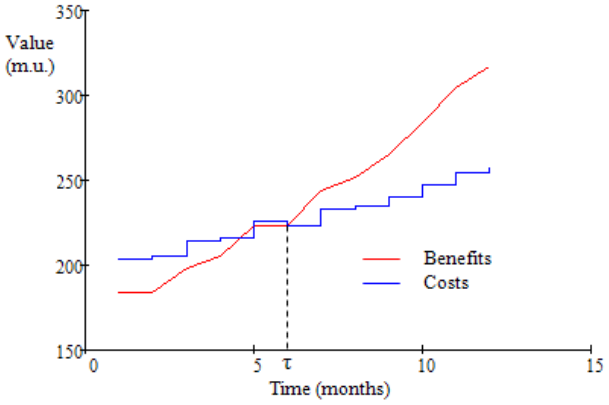

Fig. 5 The outcome of safety investment project

Numerical computation reveals investment opportunity in safety for different values of yield and volatility. Results are highly sensitive to the asymmetry of jumps size and the system architecture. Neglecting jump risk can lead to significant underestimation of the real value of investment opportunities, with negative consequences for decision-making.

CONCLUSIONS

The model was implemented as a simple, fast and efficient tool using Mathcad program, a tool in which data can be simulated by concrete elements of the application.

The advantages of the model concern the introduction of flexibility ingredient essential in decision making. It also incorporates market mechanisms that allow resumption of study in a unique way for this type of applications.

The development of a model that captures the impact of fluctuations resources (technological shocks and human error) in projects safety investment (Wiener process modeled using Poisson distribution) aims to identify management solutions that increase the value of the investment opportunity in high-tech systems.

The limits of the model are related to capturing the interdependencies and interconnections between the technical and socio-human subsystems highlighted by the higher probability of producing the accident at the system level compared to the failure rate at an indispensable functioning component level.

BIBLIOGRAPHY

1. Haimes, Y. Y. Toward a holistic approach to risk management (Guest Editorial), *Risk Analysis* 9 (1989), 147-149.
2. Covey, S. R. *The Seven Habits of Highly Effective People*. New York: Simon and Schuster (1989).
3. Sage, A. P. *Methodology for Large Scale Systems*, New York: McGraw-Hill (1977).
4. Blauberg, I. V., Sadovsky, V. N., Yudin, E.G. *Systems Theory: Philosophical and Methodological Problems*, New York: Progress Publishers (1977).
5. Haimes, Y. Y. *Hierarchical holographic modeling*, IEEE Transactions on Systems, Man, and Cybernetics. 11(1981), 606-617.
6. Burlacu, G., Dăneţ, N., Bandrabur, C., Duminică, T. *Fiabilitatea, mentenabilitate şi disponibilitatea sistemelor tehnice*. Bucureşti: Matrix Rom (2005).
7. Reason , J. *Managing the Risks of Organizational Accidents*. London: Ashgate (1996).
8. Johnson , W.G. *MORT Safety Assurance System*. New York: Marcel Dekker (1980).
9. Rasmussen , J., Svedung, I. *Proactive Risk Management in a Dynamic Society*. Stockholm: Swedish Rescue Services Agency (2000).
10. Ezell, B.C., Bennett, S.P., Von Winterfedt, D., Sokolowski, J., Collins, A.J. Probabilistic Risk Analysis and Terrorism Risk. *Risk Analysis*, vol. 30, nr. 4 (2010), 575-589.
11. Cirka, C.C., Corrigall, E. A. Expanding possibilities through metaphor: Breaking biases to improve crisis management. *Journal of Management Education*, 34 (2010), 303-323.
12. Rasmussen, J. Human error and the problem of causality in analysis of accidents. In *Human Factors in Hazardous Situations.* Oxford: Clarendon Press (1990).
13. Dhillon, B.S. *Safety and Human Error in Engineering Systems*. CRC Press (2012).
14. Dhillon, B.S. *Human Reliability, Error, and Human Factors in Engineering Maintenance: with Reference to Aviation and Power Generation*. CRC Press (2009).
15. Cioacă, C., Boşcoianu, M., Model of Assessing the Impact of Rare Events in Aviation Security Investments Projects. *Applied Mechanics and Materials*, Vol. 555 (2014), 11-17.

APPLICATIONS OF PROBABILITY THEORY TO STUDY THE INFLUENCE OF PROJECTILE'S MASS TOLERANCES ON EXTERIOR BALLISTIC

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Abstract: *In this paper is presented an algorithm for study the influence of projectile's mass tolerances on projectile exterior ballistic. The algorithm can be useful for engineers who work in design, maintenance or experimental testing of ammunitions. The paper gives an idea of how can be applied the probability theory, in general, and estimation theory in particular to establish the accepted tolerances for projectile's mass considering some exterior ballistic effects imposed.*

Key words: *point-mass trajectory, tolerances, range, deflection, point estimation, confidence intervals estimation*

1. INTRODUCTION

The application of probabilistic calculus gives us the possibility to anticipate in a scientific manner the results for design, maintenance or testing with low resources consumption.

In fact this kind of studies offers to engineers and not only a powerful instrument in evaluate the influence of their choices in: products design, experimental data interpreting or products evaluation in different stages of their lifetime cycle.

Some of these studies are made to evaluate the projectile's point-mass motion in air and evaluate the influence of changes in projectile structure on projectile's point – mass trajectory.

In this paper the study is focused on the evaluation of some main elements of the point-mass projectile's trajectory for an aerodynamic configuration of 30 mm caliber projectile.

The main elements of projectile's point – mass trajectory are calculated considering its mass deviations.

The trajectory's deviations are evaluated based on the calculated main elements of trajectory and also is evaluated the effect to the target caused by the remaining energy of projectile.

The study from this paper is organized in five stages as follows: establish the set of mass values distribution based on its nominal value and tolerances, point – mass trajectory main elements calculation for each value of mass from the set, graphical evaluation of normality distribution of each set of values, point estimation of projectile's mass and trajectory's main elements, trajectory's main elements estimation using confidence intervals.

An example of 30 mm projectile is presented in Fig.1.

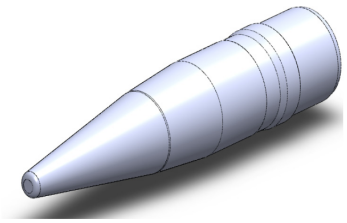

Fig. 1 Example of 30 mm caliber projectile

The study is based on a set of eighteen values for projectile mass, chosen as an example of mass measurement. The main elements of trajectory are calculated using special design software for exterior ballistic calculus for each value from the considered set of values for mass.

An example of projectile's mass tolerances calculus process based on imposed tolerances for range, maximum high, deflection and remaining velocity is presented in Figure 2.

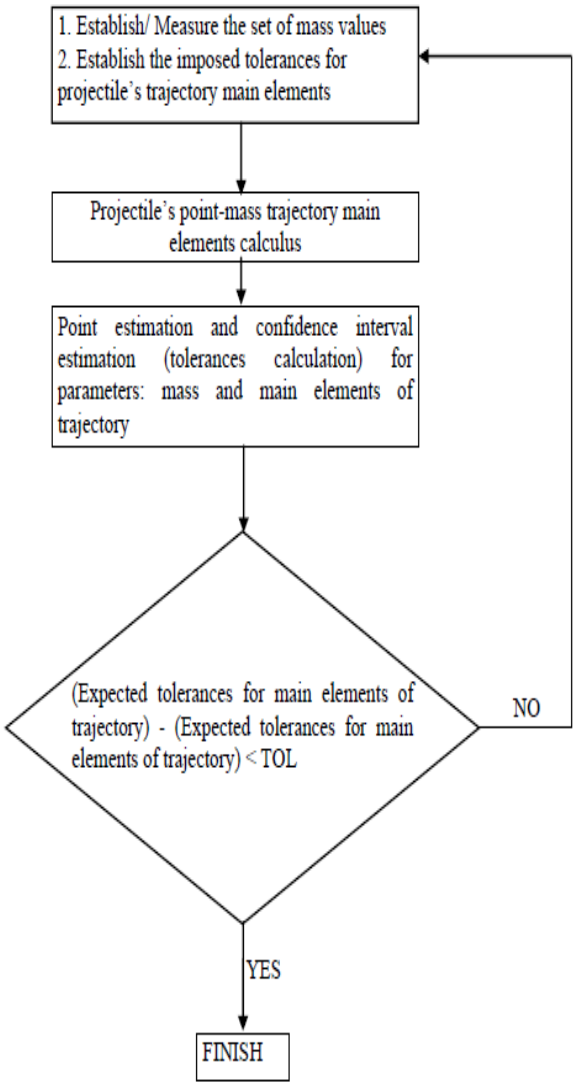

Fig. 2 Diagram of projectile's mass calculus process example

2. MATHEMATICAL MODELS USED

The study has in his five stages the following mathematical models: exterior ballistic model, point estimation for a parameter and parameter tolerances estimation using confidence intervals with a confidence level imposed [2, 3].

The mathematical model for exterior ballistic of projectile point – mass motion assumes to solve the exterior ballistic problem considering 3D point – mass projectile's trajectory (Fig. 3).

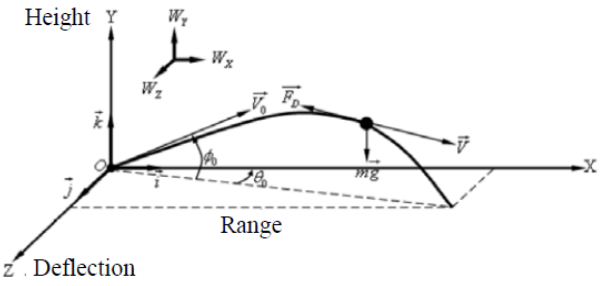

Fig. 3 Point – mass projectile's 3D trajectory

The set of equations used to calculate the 3D trajectory is [1,3]:

$$\begin{cases} \dot{V}_X = -\hat{C}_D \cdot V \cdot (V_X - W_X) \\ \dot{V}_Y = -\hat{C}_D \cdot V \cdot V_Y - g \\ \dot{V}_Z = -\hat{C}_D \cdot V \cdot (V_Z - W_Z) \\ V = \sqrt{(V_X - W_X)^2 + V_Y + (V_Z - W_Z)^2} \end{cases} \quad (1)$$

where $\hat{C}_D = \frac{\rho S C_D}{2m}$, C_D - projectile's drag coefficient, ρ - air density, S - projectile's reference surface, m - projectile's, W_X, W_Z - wind velocity, V_X, V_Y, V_Z - projectile's velocity components, g - gravitational acceleration.

Point estimation and tolerances estimation was made using the following relations [2,3]:

$$x_A \approx \bar{x}_A = \frac{1}{n}\sum_{i=1}^{n} x_i \quad (2)$$

$$\bar{s} = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(x_i - \bar{x})} \quad (3)$$

$$s = \bar{s} \cdot \sqrt{\frac{n}{n-1}} \quad (4)$$

$$|x_A - \bar{x}_A| < t(P^*, k) \cdot \frac{s}{\sqrt{n}} \quad (5)$$

where x_i - corresponding value from data set, $\bar{x}_A$ - average of data set, x_A - true value, s - empirical standard deviation, $\bar{s}$ - standard deviation, $t(P^*, k)$ - factor calculated using Student repartition, $k = n - 1$, n - number of values from data set.

Using these relations were estimated the tolerances for trajectory's main elements based on projectile's mass tolerances.

3. NUMERICAL RESULTS

Initial data used to calculate the main elements of projectile's point-mass trajectory are presented in Table 1.

Table 1. Initial data for numerical model

Parameter	Value
Caliber [mm]	30
Velocity [m/s]	880
Projection angle [deg]	30
Deflection angle [deg]	0.1
Wind velocity [m/s]	0
Air density [kg/m^3]	1.22
Drag coefficient [-]	0.3053

For projectile's mass were considered eighteen values which includes the average value of 400 grams with values for upper tolerance and lower tolerance of +5 grams and -5 grams.

Numerical results obtained for the set of projectile's mass values are exposed in Table 2.

Table 2. Numerical result for main elements of trajectory

Crt. No.	Mass [g]	Range [m]	Maxim High [m]	Remain Velocity [m/s]
1	395.00	6690.365	1890.609	148.723
2	396.00	6703.164	1893.677	148.887
3	396.75	6713.165	1895.976	149.022
4	397.00	6715.956	1896.742	149.050
5	397.75	6725.952	1899.038	149.185
6	398.25	6732.072	1900.567	149.258
7	398.50	6735.402	1901.332	149.303
8	399.00	6742.062	1902.860	149.393
9	400.00	6754.833	1905.913	149.556
10	401.00	6767.597	1908.962	149.719
11	401.50	6774.249	1910.485	149.809
12	401.75	6777.028	1911.246	149.837
13	402.25	6783.678	1912.767	149.927
14	402.75	6789.778	1914.288	150.000
15	403.00	6793.102	1915.048	150.045
16	403.25	6796.425	1915.808	150.089
17	404.00	6805.843	1918.086	150.207
18	405.00	6819.128	1921.119	150.386

In order to apply the probability theories we made data normality verification for each parameter: mass, range, maxim high and remain velocity. The graphical normality tests are presented in Figures 4 to 7.

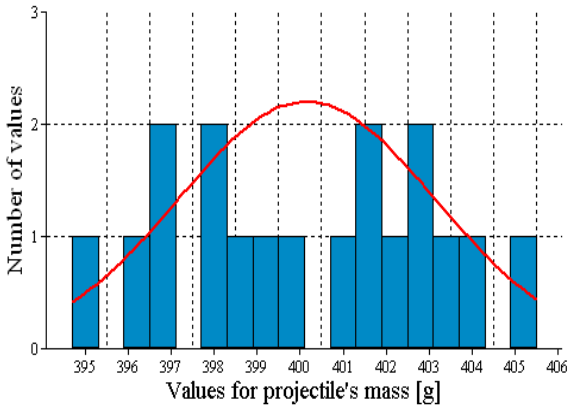

Fig. 4 Normality test results for mass

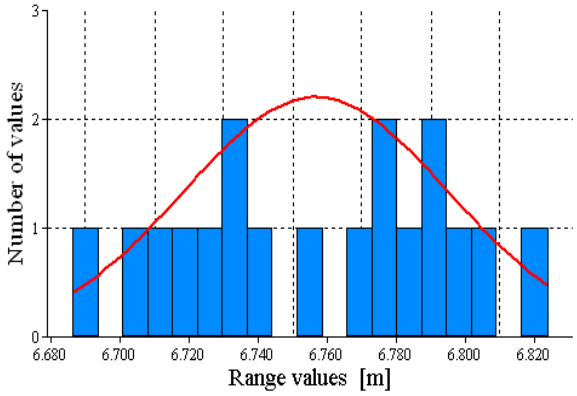

Fig. 5 Normality test results for range

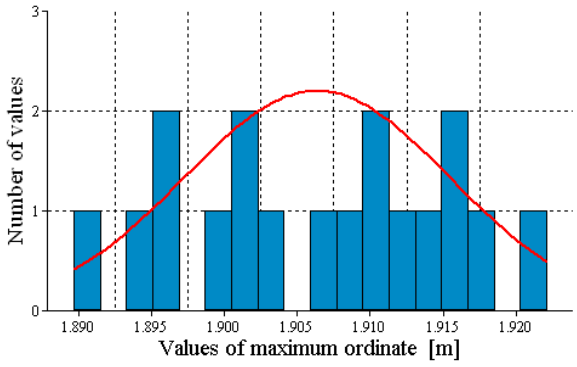

Fig. 6 Normality test results for maxim high

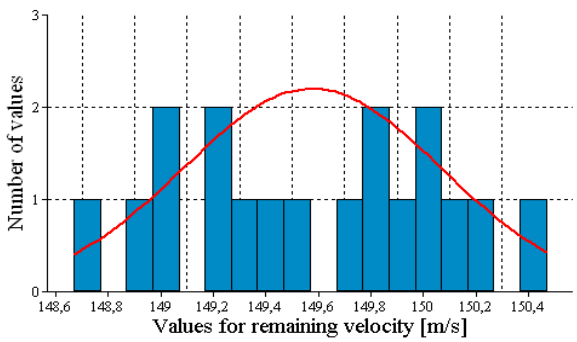

Fig. 7 Normality test results for remain velocity

Once verified the normality distribution of results was calculated the true value (point estimation) and tolerances (confidence intervals) with a confidence level imposed of 99%. The results for mass, range, maxim high and remained velocity are presented in tables 3 to 6.

Table 3. Statistical results mass data

$\bar{x}_A$	s	k	$t(P^*,k)$	$t(P^*,k)\frac{s}{\sqrt{n}}$
400.15	1.65	17	3.01	1.17

Table 4. Statistical results for range data

$\bar{x}_A$	s	k	$t(P^*,k)$	$t(P^*,k)\frac{s}{\sqrt{n}}$
6756.656	5.91	17	3.01	4.19

Table 5. Statistical results for maxim high

$\bar{x}_A$	s	k	$t(P^*,k)$	$t(P^*,k)\frac{s}{\sqrt{n}}$
1906.362	2.88	17	3.01	2.04

Table 6. Statistical results for remained velocity

$\bar{x}_A$	s	k	$t(P^*,k)$	$t(P^*,k)\frac{s}{\sqrt{n}}$
149.578	0.67	17	3,01	0.48

The statistical results offer the possibility to calculate upper and lower tolerances for each parameter: mass, range, maxim high, remained velocity (see Tables 3 to 6)

CONCLUSIONS

The main elements of trajectory were calculated using special design software for exterior ballistic calculus for each value from the considered set of values for mass. An example of projectile's mass tolerances calculus process based on imposed level of trust of 99% was presented.

From this process we can calculate with a 99% confidence the tolerances for range, maxim high, remained velocity for imposed mass tolerances.

The values for calculated parameters are presented in table 7 with tolerances.

Table 7. Tolerances results f

Parameter	Value
Mass [g]	$400.15^{+1.17}_{-1.17}$
Range [m]	$6756.656^{+4.19}_{-4.19}$
Maxim high [m]	$1906.362^{+2.04}_{-2.04}$
Remained velocity[m/s]	$149.578^{+0.48}_{-0.48}$

This kind of study can be extended on any type of parameter not only mass. Also based on probability theory can be determined the need of resources to achieve a result with an imposed level of confidence.

The usefulness of this type of study can be seen in experimental testing, design of different type of products.

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BIBLIOGRAPHY

1. McCoy, R. L., *Modern exterior Ballistics – The launch and Flight Dynamics of Symmetric Projectiles*. Schiffer Publishing Ltd. Atglen PA19310 (2012).
2. Moraru, Fl. *Elemente de teoria estimației cu aplicații în balistică*. Editura Academiei Tehnice Militare. Bucureşti (1979).
3. Surdu, G., Slămnoiu, G., Moldoveanu C., Ciuculin, A., Şomoiag P. *Metode statistice şi instrumente software realizate in – house pentru aplicații în balistică cu scopul determinării valorii adevărate a parametrilor determinați experimental.* Sisteme energetice şi Balistice. Bucureşti (2013).

THE IMPACT OF SEASONAL ADJUSTMENT ON TIME SERIES PREDICTION

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Abstract: *In this article we intend to compare the performance in term of accuracy for two models ARIMA(p,d,q)(P,D,Q)$_s$, corresponding to two kinds of time series: seasonally adjusted and not seasonally adjusted . The time series used in this work are publicly available. The measure of accuracy used is mean absolute percentage error. Experimentally, we show that the prediction accuracy is better for seasonally adjusted time series.*

Key words: *forecasting, time series, seasonally adjusted, ARIMA.*

1. INTRODUCTION

A *time series* is a sequence of observations $y_1,\ldots,y_{t-2},y_{t-1},y_t$ generated sequentially in time. The key properties of time series are: the data are not independently generated, their variance may vary in time, they are often governed by a trend and they may have cyclic components. Statistical procedures that suppose independent and identically distributed data are, therefore, excluded from the analysis of time series.

Time series analysis includes a broad spectrum of exploratory and hypothesis testing methods with two main goals: (a) identifying the nature of the phenomenon represented by the sequence of observations, and (b) forecasting , i.e. predicting future values of the time series variable.

Seasonal adjustment (SA) is the process of estimating and removing seasonal effects from a time series in order to better reveal certain non-seasonal features. The mechanics of seasonal adjustment involve breaking down a series into trend-cycle, seasonal, and irregular components:

- *Trend – cycle*: Level estimate for each month (quarter) derived from the surrounding years of observations.
- *Seasonal effects*, defined as effects that are reasonably stable in terms of annual timing, direction, and magnitude. Possible causes include natural factors (weather), administrative measures (starting and ending dates of the school year), and social/cultural/religious traditions (fixed holidays such as Christmas).
- *Irregular components*, that is anything not included in the trend-cycle or the seasonal effects (or in estimated trading day or holiday effects). Their values are unpredictable as regards timing, impact, and duration. They can arise from sampling error, non-sampling error, unseasonable weather, natural disasters, strikes, etc.

X-12-ARIMA is the seasonal adjustment software produced and maintained by the Census Bureau. It is used for all official seasonal adjustments at the U. S. Census Bureau. The original time series is not seasonal adjusted (NSA). Methods for seasonally adjusting time series are also described in [5], [6].

2. The ARIMA Model

Autoregressive Integrated Moving Average (ARIMA) processes are a class of stochastic processes used in the area of time series modeling. The application of the ARIMA methodology for the study of time series analysis is due to Box and Jenkins [1].

Let us consider $y_1 \dots y_{t-1}, y_t, y_{t+1}, \dots$ (shortly: $\{y_t\}_t$) the observations at equally spaced time moments and let $a_1 \dots a_{t-1}, a_t, a_{t+1}, \dots$ or $\{a_t\}_t$ be a white noise series consisting of independent and identically distributed random variables, whose distribution is approximately normal with mean zero and variance σ_a^2. Assume that $E(y_t) = \mu_y$ and we note $y_t - \mu_y = \tilde{y}_t$; therefore, $E(\tilde{y}_t) = 0$.

Let us consider the general ARMA(p, q) model as in [2]:

$$\tilde{y}_t = \phi_1 \tilde{y}_{t-1} + \dots + \phi_p \tilde{y}_{t-p} + a_t - \theta_1 a_{t-1} - \dots - \theta_q a_{t-q} \quad (1)$$

or, equivalently

$$\phi(B)\tilde{y}_t = \theta(B)a_t \quad (2)$$

where $\phi(B) = 1 - \phi_1 B - \phi_2 B^2 - \dots - \phi_p B^p$ is the autoregression operator of order p and $\theta(B) = 1 + \theta_1 B + \theta_2 B^2 + \dots + \theta_q B^q$ is the moving average operator of order q, with B being the backward shift operator $B y_t = y_{t-1}$, $B^k y_t = y_{t-k}$.

The general model ARIMA(p, d, q) is defined as in [3]:

$$\phi(B)(1-B)^d \tilde{y}_t = \phi(B)\nabla^d \tilde{y}_t = \theta(B)a_t \quad (3)$$

where $\nabla = 1 - B$ is backward difference, and $\nabla^d = (1-B)^d$ is the backward difference of order d.

A common assumption for many time series techniques is that the data are stationary. A stationary process has the property that the mean, variance and autocorrelation structure do not change over time. Stationarity can be defined in precise mathematical terms, but for our purpose we mean a flat looking series, without trend, constant variance over time, a constant autocorrelation structure over time and no periodic fluctuations. If the roots of polynomial $\phi(B)$ lie outside the unit circle, it may be shown that an ARMA(p, q) is stationary.

Many time series are not stationary. It is often the case that the series of first differences $w_t = y_t - y_{t-1} = (1-B)y_t$ is stationary. If a series $\{y_t\}_t$ has to be differenced once to obtain stationarity, then the model corresponding to the original series is called an integrated ARMA model of order *p, 1, q* or ARIMA(*p, 1, q)*. In practice, differencing on the first order is necessary, while differencing on the second order is rarely needed. If the original series $\{y_t\}_t$ is stationary, then it is not necessary to differentiate these series.

However, if time series manifest a periodic fluctuation (a seasonal pattern), then the general ARIMA model is defined following [3]:

$$\Phi(B^s)\nabla_s^D y_t = \Theta(B^s)a_t \quad (4)$$

where s is the number of periods in a season. Let us note the seasonal ARIMA model ARIMA$(p,d,q)(P,D,Q)_s$, where P=number of seasonal autoregressive terms, D=number of seasonal differences, Q=number of seasonal moving average terms.

In [1], Box and Jenkins suggested that the search for a good model could be based on the following:

(i) Model identification, i.e. deciding on (initial values for) the orders *p; d; q; P;D;Q*,

(ii) Estimation, i.e. fitting of the parameters in the ARIMA model,

(iii) Diagnostic checking and model criticism,

(iv) Iteration: modifying the model (i.e. the orders *p; d; q; P;D;Q*) in the light of (iii) and returning to (ii).

The implementation provided by IBM SPSS Statistics analysis package version 21 was used for ARIMA. As ARIMA is delivered as an SPSS procedure at least from version 13 of this product, we believe that the current version is error-free. The steps for producing the most appropriate ARIMA model are detailed in [6].

3. Experiments and results

The overall performance of a forecasting model is evaluated by an accuracy measure, *Mean Absolute Percentage Error (MAPE)* computed as:

$$MAPE = \frac{1}{N}\sum_{t=1}^{N}\left|\frac{y_t - \hat{y}_t}{y_t}\right| \cdot 100 \quad (7)$$

where y_t is the desired value, $\hat{y}_t$ is the predicted value for period t, and N is the number of forecasted values. *MAPE* is a common metric in forecasting applications and it measures the proportionality between the forecasting error and the actual value.

The five time series used in this section are:

- US Total New Privately Owned Housing, 01.1968 – 06.2014
- US Retail Sales and Food Services, 01.1992 – 06.2014
- Florida Construction; All Employees, 01.1990 – 06.2014
- Manufacturing Information Technology Industries Total Inventories Millions of Dollars , 01.1992 – 06.2014
- Manufacturing Wood Products Inventories to Shipments Ratio, 01.1992 – 06.2014

They are freely available at [8, 9, 10, 11, 12, 13, 14, 15, 16, 17]. Each of these time series are given both as *seasonally adjusted* (SA) and as *not seasonally adjusted* (NSA).

For the ARIMA model, the values for the coefficients p, d, q, P, D, and Q are automatically determined by the IBM SPSS software, through its internal routines.

After the forecast is induced, the MAPE values are computed and the values of MAPE are grouped in Table 1:

Table1. The MAPE values of the considered time series

SERIES	MAPE	
	NSA	SA
US Total New Privately Owned Housing	6.118693643	5.772784487
US Retail Sales and Food Services	1.289655212	0.702631293
Florida Construction;	3.606306025	2.046015739
Manufacturing Information Technology Industries	1.77913964	0.711533582
Manufacturing Wood Products Inventories to Shipments Ratio	4.135570639	2.929566385

CONCLUSION

As shown in Table 1, all the values of MAPE for SA time series are lower the ones for NSA. In summary, the MAPE values for the SA series are between 39.9% and 94.3% of the corresponding NSA MAPE scores. In four out of the five cases, the MAPE score for SA is less than 71% of the MAPE for NSA. We conclude that seasonal adjustment of time series improves the prediction performances and it is recommended to be performed as a preprocessing step before analyzing of time series, despite the supplemental computational resources needed.

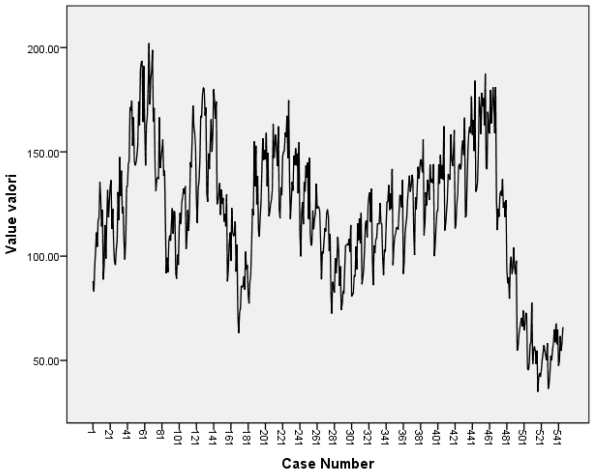

Fig. 1(a) US Total New Privately Owned Housing Units Completed; Thousands; NSA between 01.1968 and 06.2014 [8]

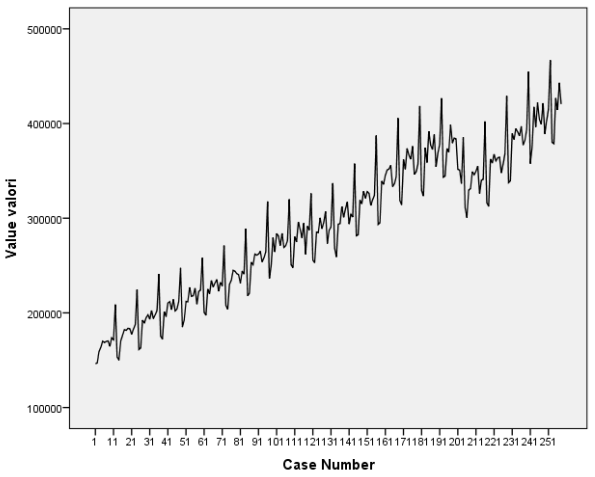

Fig. 2(a) US Retail Sales and Food Services, Total, NSA between 01.1992 and 06.2014 [10]

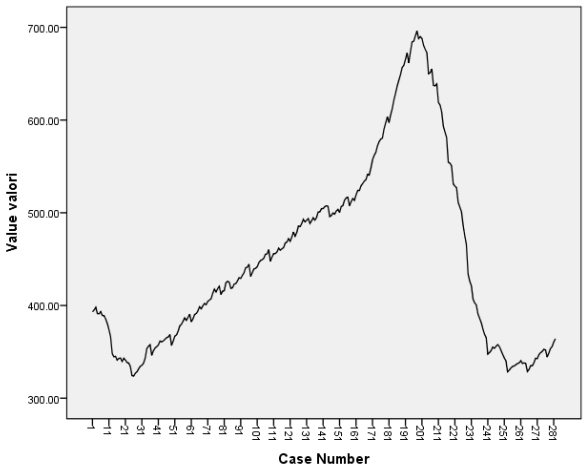

Fig. 3(a) Florida Construction; All Employees; Thousands; NSA between 01.1990 and 06.2014 [12]

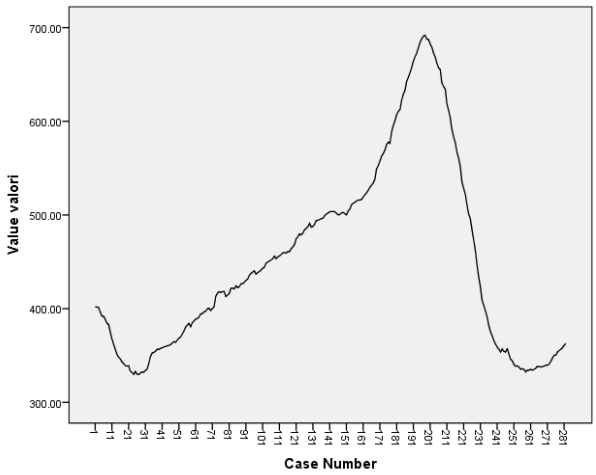

Fig. 3(b) Florida Construction; All Employees; Thousands; SA between 01.1990 and 06.2014 [13]

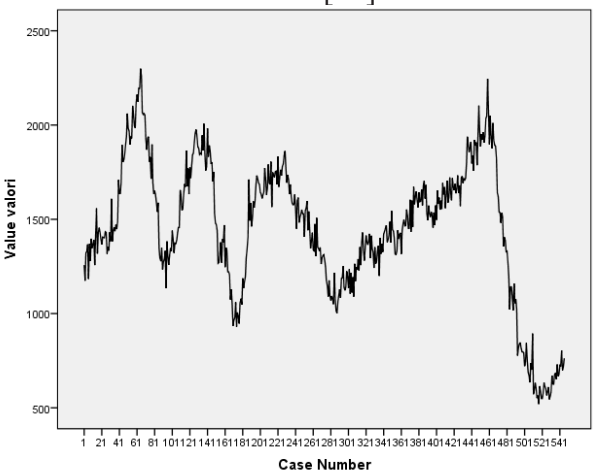

Fig. 1(b) US Total New Privately Owned Housing Units Completed; Thousands; SA between 01.1968 and 06.2014 [9]

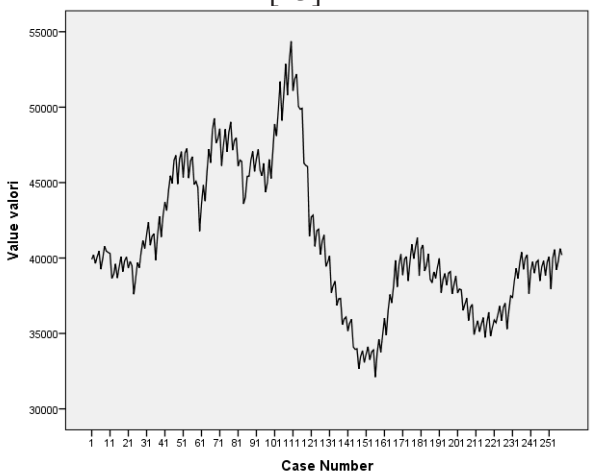

Fig. 4(a) Manufacturing Information Technology Industries Total Inventories Millions of Dollars NSA between 01.1992 and 06.2014 [14]

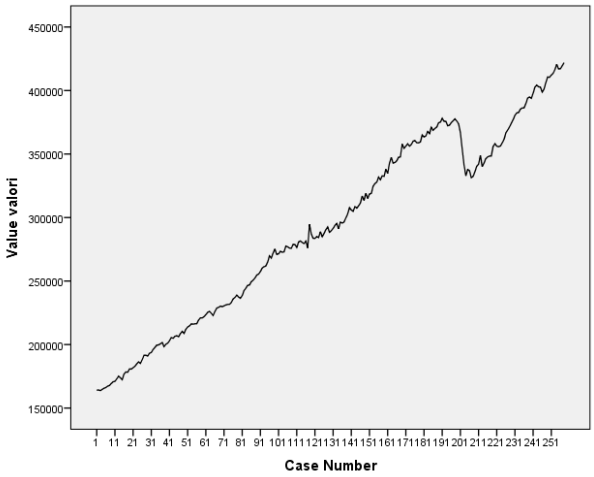

Fig. 2(b) US Retail Sales and Food Services, Total, SA between 01.1992 and 06.2014 [11]

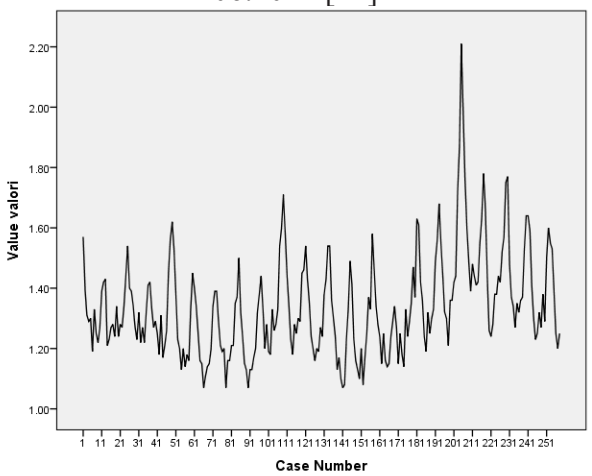

Fig. 5(a) Manufacturing Wood Products Inventories to Shipments Ratio NSA between 01.1992 and 06.2014 [16]

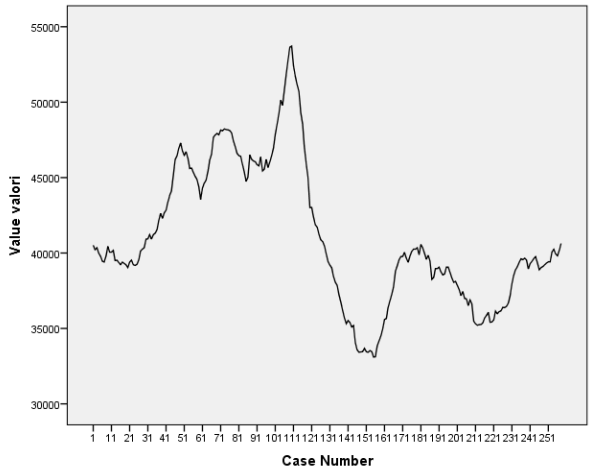

Fig. 4(b) Manufacturing Information Technology Industries Total Inventories Millions of Dollars SA between 01.1992 and 06.2014 [15]

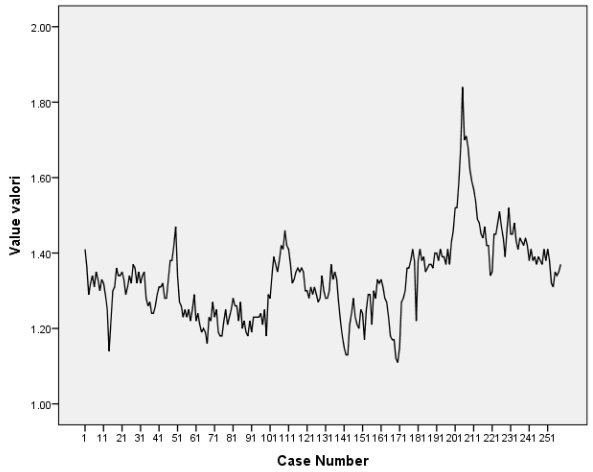

Fig. 5(b) Manufacturing Wood Products Inventories to Shipments Ratio SA between 01.1992 and 06.2014 [17]

BIBLIOGRAPHY

1. Box, G.E.P., Jenkins, G.M., *Time Series Analysis, Forecasting and control,* San Francisco: Holden-Day (1976).
2. Chatfield, C., *The Analysis of Time Series. An Introduction*, New York: Chapman & Hall/CRC(1995).
3. Popescu, T., *Time Series Application in System Analysis*, Technical Publishing House(2000) (in Romanian).
4. Sasu, A., An Application of ARIMA Models, *Bulletin of the Transilvania University of Braşov 11(**46**) - New Series, Series B1*, p. 61-68(2005).
5. Sasu A., Time series seasonal adjustment method, *Bulletin of the Transilvania University of Brasov 14(49), Series B1*. Transilvania Univ. Press-Brasov, 91-94, (2007).
6. Sasu, A., Time Series Forecasting using ARIMA Models, *8-th European Conference E-COMM-LINE* , 67e, (2007).
7. Yaffee, R.,A., McGee, M., *An Introduction to Time Series Analysis and Forecasting: With Applications of SAS and SPSS*, Academic Press(2000).
8. US Total New Privately Owned Housing Units Completed; Thousands; NSA: http://www.economagic.com/em-cgi/data.exe/cenc25/compua01
9. US Total New Privately Owned Housing Units Completed; Thousands; SA: http://www.economagic.com/em-cgi/data.exe/cenc25/compsa01
10. US Retail Sales and Food Services, Total, NSA: http://www.economagic.com/em-cgi/data.exe/cenret/nrt101nsa
11. US Retail Sales and Food Services, Total, SA: http://www.economagic.com/em-cgi/data.exe/cenret/nrt101sa
12. Florida Construction; All Employees; Thousands; NSA: http://www.economagic.com/em-cgi/data.exe/blssm/SMU12000002000000001
13. Florida Construction; All Employees; Thousands; SA: http://www.economagic.com/em-cgi/data.exe/blssm/SMS12000002000000001

14. Manufacturing Information Technology Industries Total Inventories Millions of Dollars NSA: http://www.economagic.com/em-cgi/data.exe/cenm3/uititi
15. Manufacturing Information Technology Industries Total Inventories Millions of Dollars SA: http://www.economagic.com/em-cgi/data.exe/cenm3/aititi
16. Manufacturing Wood Products Inventories to Shipments Ratio NSA: http://www.economagic.com/em-cgi/data.exe/cenm3/u21sis
17. Manufacturing Wood Products Inventories to Shipments Ratio SA: http://www.economagic.com/em-cgi/data.exe/cenm3/a21sis

APPLICATION OF PROCEDURES FOR RELATIONS ESTABLISHMENT BETWEEN NATURAL NUMBERS

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Abstract: *By adding consecutive natural numbers was developed an algebraic structure with levels called Natural procedure.It has been shown that the powers of natural numbers can be expressed in terms of these values. Double recurrence requires the concept of procedure and defining it as increasing or decreasing structure. A particular case of procedure is the coefficients of the sum writing for natural numbers powers in Natural Procedure.Combinations to obtain zero in this system are analyzed. It exemplifies the types of procedures for achieved algebraic developments.*

Key words: *powers of natural numbers, procedure, obtaining null relations, algebraic developments.*

1. INTRODUCTION

Procedures are two variables natural or integers recurrent rows. These have theoretical significance and structure with levels. This paper will present and discuss results on the definition of such procedures.
The area of study is situated in the combinatorial analysis.This paper discussed and given a theoretical and practical sense for presented relations. This paper presents the main results of works [1-8]. To these followed a methodical approach showing the importance of each relation separately.

2. NATURAL PROCEDURE

Natural procedure was given by summing consecutive natural numbers. Results obtained were treated as "natural numbers" and apply the same type of addition. Furthermore it was shown that there are two previous levels of original level considered.
We obtained the following definition relationship:

$$s_{-1}(n) = 1 \ \ \forall n \in N^*$$

$$s_0(n) = 1 + 1 + ... + 1_{(n\,times)} = n$$

$$s_1(n) = 1 + 2 + 3 + ... + n$$

$$s_2(n) = s_1(1) + s_1(2) + s_1(3) + ... + s_1(n)$$

$$s_3(n) = s_2(1) + s_2(2) + s_2(3) + ... + s_2(n)$$

$$s_t(n) = s_{t-1}(1) + s_{t-1}(2) + s_{t-1}(3) + ... + s_{t-1}(n) \qquad (1)$$

For realized sums was formulated the recurrence relation:

$$s_t(n) = s_t(n-1) + s_{t-1}(n) \qquad (2)$$

It was discovered a formula as a product that allows calculation of the sums $s_t(n)$:

$$s_t(n) = \frac{n(n+1)(n+2)\cdot ... \cdot (n+t)}{(t+1)} \qquad (3)$$

Equation (3) satisfies the recurrence (2) even for integer values of n.Based on primary results was defined Upper Natural Procedure (defined above -1 level of t).

$$s_{-1}(n) = 1 \ \ \forall n \in Z$$

(the initial value of the variable)

$$s_t(1) = 1 \ \ \forall t \in Z\, t \geq -1$$

(set value for each level)

$$s_t(n) = s_t(n-1) + s_{t-1}(n) \text{ or relation (3)}$$

(recurence) (4)

The three relations define superior natural procedure.

The most important application of the natural procedure is the decomposition of powers of natural numbers.

3. UPPER NATURAL PROCEDURE AND RIGHT NATURAL PROCEDURE

The sums of upper natural procedure form a symmetrical array given by relation:

$$s_t(n) = s_{n-2}(t+2) \ \forall n,t \in N^* \quad (5)$$

Natural procedure allows generalization to:

$\forall n,t \in Z, t \geq -1$ This generalization defines Upper Natural Procedure described above. This is the given by recurrence and the relation:

$$s_{-1}(n) = 1 \ \forall n \in Z \cdot \quad (6)$$

It is considered that at each level there is only t+2 values of sums are defined. Thus at t=-1 there is only one no value defined and procedure recurrence is not applicable. In other words, the procedure requires that the value of n does not exceed t count of -1.

Level t = -2 is independent. Provided that t and n have the same increase does not have algebraic bases. Knowing this avoid contradictions in defining the level t = -2.

Right Natural procedure is an image of Upper Natural Procedure that reverses the n to t.It is given by:

$$s_t(1) = 1 \ \forall n,t \in Z \ \ n \geq 1$$
$$s_t(n) = s_t(n-1) + s_{t-1}(n) \ \forall n,t \in Z \ \ n \geq 1 \quad (7)$$

For negative values of t it is given by:

$$s_{-t-1} = \frac{(-t+1)(-t+2)\cdot \ldots \cdot (-t+n-1)}{(n-1)!}$$
$$\forall t \in N, n \in N^* \quad (8)$$

Property 1: With condition of correlation increasing for n variable with t variable Right Natural Procedure and Upper Natural Procedure may be accepted simultaneously.

For $n \in Z$ we have:

$$s_{-1}(n) = s_{n-2}(1) = 1 \quad (9)$$

Correlation between initially levels for that was applied recurence (3) is:

$$s_{-1}(0) = s_{-2}(1) = 1 \quad (10)$$

$$s_t(0) = s_{-2}(t+2) = 0 \ t \geq 0 \quad (11)$$

These relation define level t=-2, independent for positive n. It was not defined in the negative field. It is shown that if would be defined $s_{-2}(0)$ would be its own symmetric given by (5).

The name of two procedures comes from the location of their definition values to a coordinate system with axes n abscissa axis and t of ordinates axis.

4. POWERS OF NATURAL NUMBERS

Power t+1 of a natural number is written on the basis of consecutive sums of Natural Procedure at t level as follows:

$$n^{t+1} = \sum_{i=0}^{t} a_t^i s_t(n-i) \quad (12)$$

Where the coefficients a_t^i are given by the following recurrence:

$$a_o^o = 1 \text{ şi } a_o^i = 0 \ \forall i \in Z \ i \neq 0$$
$$a_t^i = (i+1)\ a_{t-1}^i + (t+1-i)a_{t-1}^{i-1} \ \forall i \in Z \ 0 \leq i \leq t \quad (13)$$

Coefficients a_t^i represent an increasing procedure.

Following relations presents some examples of decomposition of powers of natural numbers. With $\forall n \in N$ (can be extended to $\forall n \in Z$)

$$n^2 = s(n) + s(n-1)$$
$$n^3 = s_2(n) + 4s_2(n-1) + s_2(n-2)$$
$$n^4 = s_3(n) + 1\ s_3(n-1) + 1\ s_3(n-2) + s_3(n-3)$$

$$n^5 = s_4(n) + 26s_4(n-1) + 6\ s_4 s(n-2) + 26\, s_4(n-3) + s_4(n-1)$$

$$n^6 = s_5(n) + 57s_5(n-1) + 302\, s_5(n-2) + 302 s_5(n-3) + 57 s_5(n-4) + s_5(n-5)$$

$$n^7 = s_6(n) + 120 s_6(n-1) + 1191 s_6(n-2) + 2416 s_6(n-3) + 1191 s_6(n-4) + 120 s_6(n-5) + s_6(n-6) \quad (14)$$

The procedure a_t^i is one increasing after t defined by its first level and recurrence.

For it was observed the following:

- it is symmetric;

$$a_t^i = a_t^{t-i} \ \forall i \in Z \ 0 \leq i \leq t \quad (15)$$

- nonzero values beginning with 1;

$$a_t^0 = a_t^t = 1 \quad \forall i \in Z \ 0 \leq i \leq t \quad (16)$$

-procedures has at level t nonzero t+1 values

$a_t^i \neq 0 \ \forall i \in Z \ 0 \leq i \leq t$ şi (17)

$a_t^i = 0 \quad \forall i \in Z \quad \forall i \in Z \ i < 0 \quad \forall i \in Z$ o r $i. > t$ (18)

-sum of coefficients a_t^i is a factorial number:

$$\sum_{i=0}^{t} a_t^i = (t+1)! \ \forall t \in Z, t \geq 0 \tag{19}$$

An important consequence of the writings of powers of natural numbers is the easy calculation of the sum of consecutive natural numbers powers:

$$S_{t+1}(n) = 1^{t+1} + 2^{t+1} + ... + n^{t+1} = \sum_{i=0}^{t} a_t^i s_{t+1}(n-i) \tag{20}$$

Writing in sum for powers of natural numbers (12) can be compared with that known given by the recurrence:

$$(n+1)^{t+1} = 1 + C_{t+1}^1 S_t(n) + C_{t+1}^2 S_{t-1}(n) + C_{t+1}^3 + ... + C_{t+1}^t S_1(n) + n \tag{21}$$

This can be written as a sum, in a manner similar to equation (12).

$$n^{t+1} = 1 + \sum_{k=0}^{t} C_{t+1}^k S_k(n-1) \tag{22}$$

5. FORMULAS FOR MULTIPLICATION AND DIFFERENCES

The main observation is that relations for writing natural numbers powers (12) is independent of quality natural number for n and the it is applicable to real or complex numbers $n \to x$. Coefficients a_t^i are described only by the variable t. Acting on it condition that it is natural.

There have been deducted a number of important relations. Multiplication is given by the the following relation:

$$a \cdot b = s(a+b) - s(a) - s(b) \ \forall a, b \tag{23}$$

You can define generalized multiplication formula:

$$\sum_{k=0}^{t-1} s_k(a) \cdot s_{t-1-k}(b) = s_t(a+b) - s_t(a) - s_t(b) \ \forall a, b \tag{24}$$

The difference formula is based on the relation:

$$n^{t+1} - (n-1)^{t+1} = \sum_{i=0}^{t+1} a_t^i s_{t-1}(n-i) \tag{25}$$

This keeps coefficients a_t^i but decreases the the index sum attached.This decrease of the sum can be generalized by introducing *differences of differences.* This is following relation:

$${}^{k+1}\Delta_n^{t+1} \overset{def}{=} {}^{k}\Delta_n^{t+1} - {}^{k}\Delta_{n-1}^{t+1} \tag{26}$$

With:

$${}^{0}\Delta_n^{t+1} \overset{def}{=} n^{t+1} \tag{27}$$

The differences can be easily calculated according to n by following relation:

$${}^{k}\Delta_n^{t+1} = \sum_{j=0}^{k} C_k^j (-1)^j (n-j)^{t+1} \tag{28}$$

The differences are expressions with power $t+1$ of consecutive natural numbers written backwards from n.

Applying writing powers of natural numbers in the system coefficients a_t^i we obtain the relation:

$$\sum_{j=0}^{k} C_k^j (-1)^j (n-j)^{t+1} = \sum_{i=0}^{t} a_t^i s_{t-k}(n-i) \tag{29}$$

Order difference k can grow indefinitely. Thus we have two particular applications of this relation:

To $k = t+1$ have:

$$\sum_{j=0}^{k} C_{t+1}^j (-1)^j (n-j)^{t+1} = \sum_{i=0}^{t} a_t^i = (t+1) \tag{30}$$

To $k \geq t+2$ have:

$$\sum_{j=0}^{k} C_k^j (-1)^j (n-j)^{t+1} = 0 \tag{31}$$

This show that there is a sum of t+1 power for over t+1 consecutive integers form a preset null combination.

6. THE PRODUCT OF CONSECUTIVE INTEGER NUMBERS

Into decomposition of powers of natural numbers appears term $s_t(n-i)$. For this we have a write product and one in sum.

$$s_t(n-i)=\frac{(n-i)(n-i+1)(n-i+2)...(n-i+t)}{(t+1)}$$

(32)

$$s_t(n-i)=\frac{1}{(t+1)}\prod_{k=0}^{t}(n-i+k) \quad (33)$$

$$s_t(n-i)=\frac{1}{(t+1)}\sum_{j=0}^{t+1}R_{i,t}^{j}n^{t+1-j} \quad (34)$$

The calculation of polynomial coefficients $R_{i,t}^{j}$ show a recurrent development.This calculation is based on considering the set:

$$M_t^i=\{-i,-i+1,-i+2,...,-i+t\} \quad (35)$$

The elements of this set we note general with m_t^i. Coefficients $R_{i,t}^{j}$ will be calculated as the sum of all products of size j.for elements form M_t^i.A general writing of this relationship is:

$$R_{i,t}^{j}=\sum_{C_i^j\ terms}\ \prod_{j\ terms}m_t^i \quad (36)$$

The following are some applications of calculating these coefficients.

$$(n-i)(n-i+1)=n^2+[(-i)+(-i+1)]n+(-i)(-i+1) \quad (37)$$

$$\begin{aligned}&(n-i)(n-i+1)(n-i+2)\\&=n^3+[(-i)+(-i+1)+(-i+2)]n^2+\\&[(-i)(-i+1)+(-i)(-i+2)+(-i+1)(-i+2)]n\\&+(-i)(-i+1)(-i+2)\end{aligned} \quad (38)$$

Coefficients $R_{i,t}^{j}$ can be written as a polynomial of the variable i. Thus from previous developments can identify coefficients $R_{i,t}^{j}$:

$$t=1\ \ R_{i,1}^{0}=1,\ R_{i,1}^{1}=-2i+1,\ R_{i,1}^{1}=i^2-i \quad (39)$$

$$t=2\ R_{i,2}^{0}=1, R_{i,2}^{1}=-3i+3 \quad (40)$$

$$R_{i,2}^{2}=3i^2-6i+2, R_{i,2}^{3}=-i^3+3i^2-2i \quad (41)$$

For developments follows that have by definition:

$$R_{i,t}^{0}=1 \quad (42)$$

It is noted that relation takes place:

$$M_t^{i+1}\bigcap M_t^i=M_{t-1}^i \quad (43)$$

Based on this relationship is deduced following recurrence formula for coefficients $R_{i,t}^{j}$:

$$R_{i,t}^{j}-R_{i+1,t}=(t+1)R_{i,t-1}^{j} \quad (44)$$

This relation is important because it allows working with coefficients $R_{i,t}^{j}$ other than definition or direct calculation. It is an example of decreasing procedure (after t).

The values at the higher level generates the values on the lower level.It has been shown that takes place the relation:

$$\sum_{i=0}^{t}a_t^iR_{i,t}^{j}=0\ \ \forall 0<j\le t \quad (45)$$

This represents t relations for annulment in coefficients system a_t^i. For this relation will present checks:

$$t=1\ j=1\ \sum_{i=0}^{1}a_1^iR_{i,1}^{1}=1\cdot1+1\cdot(-1)=0 \quad (46)$$

$$t=1\ j=2\ \sum_{i=0}^{1}a_1^iR_{i,1}^{2}=1\cdot0+1\cdot0=0 \quad (47)$$

It is noted that the relation for t, j=t+1 is identical zero and can not be used to characterize the coefficients a_t^i.

For t=2 j=1 we have:

$$\sum_{i=0}^{2}a_1^iR_{i,2}^{1}=1\cdot3+4\cdot0+1\cdot(-3)=0 \quad (48)$$

For t=2 j=1 we have:

$$\sum_{i=0}^{2}a_1^iR_{i,2}^{2}=1\cdot2+4\cdot(-1)+1\cdot2=0 \quad (49)$$

In the following we verify the functionality of the formulas presented in the calculation of n^{t+1}

$$n^{t+1}=\sum_{i=0}^{t}a_t^is_t(n-i)=$$

$$\sum_{i=0}^{t}a_t^i\frac{1}{(t+1)}\sum_{j=0}^{t+1}R_{i,t}^{j}n^{t+1-j}=$$

$$\frac{1}{(t+1)!}\sum_{i=0}^{t}\sum_{j=0}^{t+1}R_{i,t}^{j}\,a_t^in^{t+1-j}=$$

$$\frac{1}{(t+1)}\sum_{j=0}^{t+1}\sum_{i=0}^{t}R_{i,t}^{j}\,a_t^in^{t+1-j}=$$

$$\frac{1}{(t+1)}\sum_{j=0}^{t+1}\sum_{i=0}^{t}R_{i,t}^{j}\,a_t^in^{t+1-j}=$$

$$\frac{1}{(t+1)}\sum_{j=0}^{t+1} n^{t+1-j}\sum_{i=0}^{t} R_{i,t}^{j}\, a_t^i =$$

$$\frac{1}{(t+1)}\, n^{t+1}\sum_{i=0}^{t} R_{i,t}^{0} a_t^i +$$

$$\frac{1}{(t+1)}\sum_{j=1}^{t+1} n^{t+1-j}\sum_{i=0}^{t} R_{i,t}^{j}\, a_t^i =$$

$$\frac{1}{(t+1)}\, n^{t+1}\sum_{i=0}^{t} 1\cdot a_t^i + \frac{1}{(t+1)}\sum_{j=1}^{t+1} n^{t+1-j}\cdot 0 =$$

$$\frac{1}{(t+1)}\, n^{t+1}\cdot(t+1) = n^{t+1} \qquad (50)$$

7. DETERMINATION OF a_t^i COEFFICIENTS BY THE $R_{i,t}^j$ COEFFICIENTS

Consider the system:

$$\sum_{i=0}^{t} a_t^i R_{i,t}^j = 0 \quad 0 \le i \le t \quad 1 \le j \le t \qquad (51)$$

(t relations)

$$\sum_{i=0}^{t} a_t^i = (t+1)! \quad j,i,t \in N \qquad (52)$$

(relation t+1 for j=0)

Property 2: Coefficients a_t^i are obtained as unique solution of the system of t+1 relations with t+1 unknowns, the system is compatible determined.

It is shown that the determinant of the system matrix verifies the following recurrence:

$$\Delta_t = (-1)^{t-1}(t+1)^t\,\Delta_{t-1} \quad \forall t \in N^* \qquad (53)$$

and by direct calculation we have first term of the recurrence:

$$\Delta_1 = \begin{vmatrix} 1 & -1 \\ 1 & 1 \end{vmatrix} = 2 \neq 0 \qquad (54)$$

Thus for any natural number t coefficients a_t^i are uniquely determined in the coefficients system $R_{i,t}^j$.

Assume the presence of a row of numbers with the property that:

$$\sum_{i=0}^{t} a_t^i A_t^i = 0 \qquad (55)$$

Substituting this relation t+1 with relation we obtain a homogeneous system that to have t solutions other of the trivial solution and no coefficients a_t^i exist, we have:

$$A_t^i = \sum_{j=1}^{t} w_t^j R_{i,t}^j \qquad (56)$$

In other words, some values A_t^i are linear combinations of coefficients $R_{i,t}^j$. Algebraic relations not say if the w_t^j coefficients are integers or irrational (where A_t^i are integers).

8. DECREASING PROCEDURE α_t^i

Consider a fixed level and the sum

$$\sum_{i=0}^{t} a_t^i s_t(n-i).$$

Recurrence natural procedure allows the calculation of a lower level sums as differences of consecutive sums after i at the upper level.

This downward trend has led to the idea to define a set of coefficients α_t^i at t level and then by downwards procedure to get access at lower levels .

We have:

1. The sum $\sum_{i=0}^{t} a_t^i \alpha_t^i$ shows itself utility

2.Define the coefficients α_t^i for $0 \le i \le t, i \in N$ with definition property for the lower level:

$$\alpha_t^i - \alpha_t^{i+1} = \alpha_{t-1}^i \qquad (57)$$

This has the generalization:

$$\alpha_p^i - \alpha_p^{i+1} = \alpha_{p-1}^i \quad 0 \le p < t,\ p \in N \qquad (58)$$

Property 3: Definition of coefficients α_t^i occurs for $0 \le i \le p, i \in N$. This definition is decreasing relative to the t level. (like triangle with pointing down).

Property 4: (lowering into the system of coefficients a_t^i)

In the system of coefficients a_t^i a relation type $\sum_{i=0}^{t} a_t^i \alpha_t^i$ has the image at level a_{t-1}^i given by:

$$\sum_{i=0}^{t} a_t^i \alpha_t^i = \sum_{i=0}^{t-1} a_{t-1}^i [(i+1)\alpha_t^i + (t-i)\alpha_t^{i+1}] \quad (59)$$

Formula shall be demonstrated by applying the recurrence coefficients a_t^i and re-index of terms. Relationship is independent of the defining coefficients α_t^i, however, require the same type of index after i for them A direct application of this relationship is:

$$\sum_{i=0}^{t} a_t^i s_t(n-i) = \sum_{i=0}^{t-1} a_{t-1}^i [(i+1)s_t(n-i) + (t-i)s_t(n-i-1)] \quad (60)$$

In principle lower the in coefficient system a_t^i can be applied between any two consecutive levels t and t-1 without upper level to the maximum defined t. The application is defined to value t=1 into relation

Property 5: A defined sum of type $\sum_{i=0}^{t} a_t^i \alpha_t^i$ at level t has image at all lower levels in the system of a_t^i coefficients.

This will write:

$$\sum_{i=0}^{t} a_t^i \alpha_t^i = \sum_{i=0}^{f} a_f^i \ {}^f\beta_t^i \ \forall\ 0 \le f \le t-1 \ f \in N \quad (61)$$

Regardless of level f to which descends in a_t^i coefficient system values ${}^f\beta_t^i$ are defined at t level, they are based on the values α_t^i defined at the t level.

Property 6: By lowering in the system of a_t^i coefficients transfer defining the type of procedure values to values at lower levels ${}^f\beta_t^i$.

Demonstration:

A check between the t and t-1 levels is sufficient, the calculation between the other levels take places similarly. Either:

$${}^{t-1}\beta_t^i = (i+1)\alpha_t^i + (t-i)\alpha_t^{i+1}$$

Then:

$$[(i+2)\alpha_t^{i+1} + (t-i-1)\alpha_t^{i+2}] = [(i+1)\alpha_t^i + (t-i)\alpha_t^{i+1}] - (i+1)(\alpha_t^i - \alpha_t^{i+1}) + (t-i-1)(\alpha_t^{i+1} - \alpha_t^{i+2}) + \alpha_t^{i+1} - \alpha_t^{i+1} =$$

$$[(i+2)\alpha_t^{i+1} + (t-i-1)\alpha_t^{i+2}] =$$

$$(i+1)\alpha_{t-1}^i + (t-i-1)\alpha_{t-1}^{i+1} = {}^{t-1}\beta_{t-1}^i$$

Is obtained:

$${}^{t-1}\beta_t^i - {}^{t-1}\beta_t^{i+1} = {}^{t-1}\beta_{t-1}^i \quad (62)$$

Exponent left is part of the the name β coefficients will not change with of t variabile. It looks like that the same type of procedure (58) associated with one level will send lower levels .For α_t^i coefficients their recurrence relation to leads to the possibility express them based on values $\alpha_p^0 \ \ 0 \le p \le t$.

So these are define at t level, by (t+1) values indexed by i or (t+1) values indexed after p at i=0. The transition between the two expressions is given by:

$$\alpha_t^i = \sum_{p=0}^{i} (-1)^p C_i^p \alpha_{t-p}^0 \quad (63)$$

$0 \le p \le i \ \ 0 \le i \le t \ \ p,i,t \in N$

It shows that increasing values of i is equivalent to lowering of p at i = 0.

9. STUDY OF RELATION $\sum_{i=0}^{t} a_t^i \alpha_t^i = 0$

The values α_t^i are defined by a calculation process applied to the t level. In this discussion is not considered the method calculation it is important that it exists and the following take place:

1. Recurrence takes place:

$$\alpha_p^i - \alpha_p^{i+1} = \alpha_{p-1}^i \ 0 \le p \le t, \ p \in N \quad (64)$$

2. $\alpha_t^i \in Z$ (are integers) (65)

Property 7: The relation $\sum_{i=0}^{t} a_t^i \alpha_t^i = 0$ (66)

occurs if and only if: $\alpha_t^i = A_t^i \ 0 \le i \le t \ i,t \in N$ (67)

$$A_t^i = \sum_{j=1}^{t} w_t^j R_{i,t}^j \quad (68)$$

Motivation: Determination unique of a_t^i coefficients in the system.of coefficients $R_{i,t}^j$

Values A_t^i are determined by coefficients w_t^j.

It is important to determine whether they are rational or irrational. We define a decreasing procedure similar to the values α_t^i for values A_t^i starting from the t level. This is given by the relations:

$$A_t^i - A_t^{i+1} \overset{def}{=} A_{t-1}^i \tag{69}$$

$$A_p^i - A_p^{i+1} \overset{def}{=} A_{p-1}^i \; 0 \le p < t,\; p \in N \tag{70}$$

Property 8: Defined values A_p^i have the following calculation relation:

$$A_p^i = \frac{(t+1)}{(p+1)} \sum_{j=0}^{p} w_t^{j+t-p} R_{i,p}^j \; 0 \le p < t,\; p \in N \tag{80}$$

We show the calculation for A_{t-1}^i

$$A_{t-1}^i = A_t^i - A_i^{i+1} = \sum_{j=1}^{t} w_t^j (R_{i,t}^j - R_{i+1,t}^j) =$$

$$\sum_{j=1}^{t} (t+1\} w_t^j R_{i,t-1}^{j-1} \underset{j-1 \to j}{=} (t+1) \sum_{j=0}^{t-1} (t+1\} w_t^{j+1} R_{i,t-1}^j \tag{81}$$

The formula obtained for lower levels is not assimilated directly into the t level. For this missing term j = 0 (constant term).

Property 9: We have successive implications:

$$1) \sum_{i=0}^{t} a_t^i \alpha_t^i = 0; \tag{66}$$

$$2) \; \alpha_t^i = A_t^i \; 0 \le i \le t \; i,t \in N \tag{67}$$

$$3) \; \alpha_p^i = A_p^i \; 0 \le i \le p \; 0 \le p \le t,\; p \in N \; i,t \in N \tag{82}$$

4) Coefficients w_t^j are rational and (t +1)! is a common multiple of their denominators. (83)

To statement 3 applies to the decrease in procedure both for α_p^i values and A_p^i values.

To calculate:

$$\sum_{i=0}^{p} a_p^i \alpha_p^i =$$

$$\sum_{i=0}^{p} a_p^i A_p^i =$$

$$\sum_{i=0}^{p} a_p^i \frac{(t+1)}{(p+1)} \sum_{j=0}^{p} w_t^{j+t-p} R_{i,p}^j =$$

$$\sum_{j=0}^{p} \frac{(t+1)}{(p+1)} w_t^{j+t-p} \sum_{i=0}^{p} a_p^i R_{i,p}^j =$$

$$+ \frac{(t+1)}{(p+1)} w_t^{t-p} \sum_{i=0}^{p} a_p^i R_{i,p}^0$$

$$+ \sum_{j=1}^{p} \frac{(t+1)}{(p+1)} w_t^{j+t-p} \sum_{i=0}^{p} a_p^i R_{i,p}^j =$$

$$+ \sum_{j=1}^{p} \frac{(t+1)}{(p+1)} w_t^{j+t-p} \; 0 =$$

$$+ \frac{(t+1)}{(p+1)} w_t^{t-p} (p+1) = (t+1) \; w_t^{t-p} \tag{84}$$

Obtain the relation:

$$\sum_{i=0}^{p} a_p^i \alpha_p^i = (t+1) \; w_t^{t-p} \tag{83}$$

The sum of of the left is an integer from the definition of values α_t^i (supported by a separate calculation process). By applying decrease in procedure will get for all α_p^i integer values. It also requires the right member to be integer. Thus was obtained statement 4).

By lowering the system of a_t^i coefficients of the relation $\sum_{i=0}^{t} a_t^i \alpha_t^i = 0$ are obtained identically zero relations that do not provide any additional information.

$$\sum_{i=0}^{t} a_t^i \alpha_t^i = \sum_{i=0}^{t-1} a_{t-1}^i [(i+1)\alpha_t^i + (t-i)\alpha_t^{i-1}] =$$

$$\sum_{i=0}^{t-1} a_{t-1}^i \sum_{j=1}^{t} w_t^j [(i+1) R_{i,t}^j + (t-i) R_{i+1,t}^j] =$$

$$\sum_{i=0}^{t-1} a_{t-1}^i \sum_{j=1}^{t} w_t^j [(i+1)(R_{i,t}^j - R_{i+1,t}^j) + (t+1) R_{i+1,t}^j] =$$

$$\sum_{i=0}^{t-1} a_{t-1}^i \sum_{j=1}^{t} w_t^j [(i+1)(t+1) R_{i,t-1}^{j-1} + (t+1) R_{i+1,t}^j] =$$

$$\sum_{i=0}^{t-1} a_{t-1}^i \sum_{j=1}^{t} w_t^j \; (t+1) [-(-i-1) R_{i,t-1}^{j-1} + R_{i+1,t}^j] =$$

$$\sum_{i=0}^{t-1} a_{t-1}^i \sum_{j=1}^{t} w_t^j \; (t+1) [-R_{i+1,t}^j + R_{i+1,t}^j] =$$

$$\sum_{i=0}^{t-1} a_{t-1}^{i} \cdot 0 = 0 \qquad (85)$$

Property 10: The existence a relation type

$$\sum_{i=0}^{t} a_t^i \alpha_t^i = 0$$

the same type relations will be generates at t level.

By applying the recurrence relation $\alpha_t^i - \alpha_t^{i+1} = \alpha_{t-1}^i$ is obtained:

$$\sum_{i=0}^{t} a_t^i (\alpha_{t-1}^i + \alpha_t^{i+1}) = 0 \qquad (86)$$

This relation is the same type as the original because it respects the the relation:

$$(\alpha_{t-1}^i + \alpha_t^{i+1}) - (\alpha_{t-1}^{i+1} + \alpha_t^{i+2}) = \alpha_{t-2}^i + \alpha_{t-1}^{i+1} \quad (87)$$

By generalization of method is obtained relations type:

$$\sum_{i=0}^{t} a_t^i \sum_{k=0}^{f} C_f^k \alpha_{t-f+k}^{i+k} = 0 \ \ f \in N \qquad (88)$$

f is a free variable thus generate an infinite number of relations same type as the original which will be each of type A_t^i It was shown that regardless of the which relation (depending on f) start at t=0 we obtain the same relation and the for t=1, we obtain a relation independent of f. Relations given by the formula (88) combines levels of α_t^i procedure

CONCLUSIONS

Developments indicate a particular algebraic field. Therefore concepts were introduced (classification of procedures after t):

- direct defined procedure (E.g. natural procedure);
- increasing recurrence defined procedure E.g.: a_t^i;
- decreasing defined procedure Eg, ${}^{f}\beta_t^i$, A_t^i, the levels t=0, and t=-1 of the natural procedure;
- recursively defined procedure and inputs at one level (given by the variable n or t) E.g:

Upper natural procedure and Right natural procedure, procedure type α_t^i;

- procedures defined as an input at each level. E.g.: α_p^i for i=0.

In the paper were present relations that show functionality of algebraic system.

The main result obtained in this paper is given by property 9. Particular characterizations of the relations of type (66) are given by relations (85) and (88).

BIBLIOGRAPHY

1. Remus Boboescu *Decomposition of sums of powers of natural numbers into natural procedure application in the study of Fermat's great theorem,* Unpublished manuscript Timisoara 2002.
2. Remus Boboescu The Natural Procedure. Construction and Applications, *Octogon Mathematical Magazine* Vol.11. No.1 April 2003.
3. Remus Boboescu The Decomposition of the Natural Numbers` Powers as a Function of the Sums of the Basic Natural Procedure *Octogon Mathematical Magazine* Vol.11. No.1 April 2003.
4. Remus Boboescu Applying the Sums of the Natural Procedure to the Study of Fermat`s Great Theorem *Octogon Mathematical Magazine* Vol.11. No.1 April 2003.
5. Remus Boboescu, The Study of Fermat`s Great Theorem Using Modulo 6 Rest Classes *Octogon Mathematical Magazine* Vol.12. No.1 April 2004.
6. Boboescu Remus Studies on the $a_t^i = (i+1)a_{t-1}^i + (t+1-i)a_{t-1}^{i-1}$ recurence, *Proceedings of the 11th internațional conference Land forces academy „ Nicolae Bălcescu" Sibiu* 2006 p:55-62.
7. Boboescu Remus Aplications of natural procedure in the study of Fermat's theorem *Proceedings of the 13th internațional conference Land forces academy „ Nicolae Bălcescu"* Sibiu 2007 p: 135-141.
8. Boboescu Remus Algebric calculations regarding the behavior of the natural numbers'powers *Proceedings of the 12th internațional conference Land forces academy „ Nicolae Bălcescu"* Sibiu 2007 p:38-43.

EMPIRIC MANAGEMENT DENYING LIFE EXPERIENCE OF A RESPONSIBLE INDIVIDUAL'S AUTONOMY

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Abstract: : *Democracy is to respect the two fundamental rights of human beings: the right to a favorable environment and the right to assert one's limits. Empiric management is the cancellation of a person's spirit and personality by ignoring their individuality and denying their life experience. It is the violation of a responsible individual's autonomy by the act of not consulting/asking/informing them about the management decisions that will affect their chances of solving problems in their work or life.*

Key words: *Dominating/Influence/Verbal abuse/Repressed feelings of personal impotence/Victory of good over evil in ourselves*

1. INTRODOUCE

Constant verbal abuse "brainwashes" people by victimizing them.

Becoming aware of the fact that verbal abuse, regardless of its context, (family or work), consists of lies, enables the attenuation of the negative statements, particularly if we are dealing with permanent abuse.

The sheer acknowledgment of the oppressive effect of the statements of those who impose themselves by verbal abuse, (reproaches/ accusations/criticism/, mocking/ /contradiction of individual experience), followed by the countermanding of trust, represents the passport to freeing one's self from the victimization and a first step to discovering the personal truth that turns the victim into a survivor.

Psychological release from under the influence of abuse, similar to surviving a catastrophe, does not translate into building an identity around the act of being victimized or of having surpassed this particular trial.

It simply means that by surviving, one can realize how that was possible, gaining the right to teach others how to avoid abusive relationships, for instance.

Every abusive relationship has a basic dynamics, pinpointed by the studies performed by ALICE MILLER on the effects of early childhood experiences upon adult behavior.

To this we may add the findings of KAREN HORNEY in the field of ideal self-image.

All studies set out from the hypothesis that both the aggressor and the victim perceive reality as dominating power based.

In the early childhood everybody (with very few exceptions) starts becoming acquainted with the dominating power and, as they get older and start benefiting from quality education, they become aware of the reality of personal power.

Finding the right answer to the following questions becomes an issue:

– Why is it that, leaving from the same initial conditions, that is the reality of the dominating power, some people become aggressors while others become victims?

– Why is it possible for the victim to evolve by becoming aware of his/her personal power?

– Why does the aggressor remain captive in search of the power to dominate/submit instead of seeking reciprocity?

The answer to these questions may be found in the early childhood of people, be they aggressors or victims.

2. THE VICTIM'S AND AGGRESSOR'S CHILDHOOD

Scientific studies claim that the typical victim was brought up in the reality where parents' authority over their children was improperly used, often due to ignorance and with the best of intentions.

Submission and dominating power, as a result of the verbal abuse dominating the child's life, make his feelings/ emotions not to be justifiable or acceptable. In some cases, the young victim may have a neurotic father or one that is not involved in his/her life, or simply absent/indifferent, while in other situations the aggressors are actually the mothers /relatives/ teachers or persons sitting with the children while their parents are away.

The typical aggressor was brought up in the same climate based on dominating power, where one must impose oneself on others by verbal abuse as the sole chance to exist.

What sets the aggressors apart though is the fact that their emotions and feelings have never been validated/ accepted by other persons. Why? Because, in the aggressor's childhood, there was not a single witness who showed them compassion / sympathy in hard times.

That is how an aggressor comes to believe that nothing from what is happening to him/her is right, that everything is fair to him/her and that the sense of pain he/she is getting must not be acknowledged as true/real, as long as no one else around them does.

This is the life lesson learned by the aggressor as early as from his childhood: to prohibit access in the area of the conscience of his emotions /feelings, to deny his own pain, to adapt by remaining captive in the reality of the power of the powerful to dominate the weak, who must be despised and turned into victim as punishment for their weakness.

The deformed children put to death in SPARTA are the most relevant example to contemporary people on the reality of the dominating power in a world of aggressors.

To every child, the parents / relatives / teachers / adults in general, are never wrong. In the eyes of the children these authority figures are God-like.

Therefore, the victim has no other option but to believe that something is wrong with him/her, with the way he/she expresses himself/herself, with the impression he/she has on others or perhaps with his/her emotions /feelings or even his/her perception of reality itself.

That is how, those of us who manage to evolve and enter the reality of personal power without, however, acquiring a typical self-esteem, become victims.

The victim is aware of his/her pain. This is what sets him/her apart from the aggressor. The fact that he/she did not lose the ability to feel empathy/compassion towards himself/herself, allows him/her to feel the same towards another person, which will provide him/her with the reasons to seek understanding and mutuality.

Rejecting the possibility of acknowledging his own pain (emotions/feelings), the aggressor, as child, will not be able to experience empathy/ compassion, which is why he will not surpass the threshold of personal power, not even as an adult. ALICE MILLER describes what sets apart the aggressor from the victim as" the absence or presence of a benevolent witness in their childhood", fact that will lead to every mistreated child to become either tyrant, (by directing his repressed feelings of helplessness against his fellow men), or artist (by accepting/ acknowledging /understanding his own pain, learning to sublime the emotions in a liberating creation, good for society).

The fact is that aggressors feel, it is in their right to have that kind of attitude towards their victims, apparently not understanding that they are causing them to suffer in order to feel strong by dominating.

This may be explained by the state of helplessness, the aggressor experiences as result of repressing the childhood emotions/feelings that surface in the shape of a compulsive, revanchist behavior, seeking the dominating power.

Although the impotence and pain from his/her childhood continue to not be acknowledged / remembered / accepted because "they must not exist", they are bound to surface in an uncontrollable way. The aggressor's mind encloses the agony of a sensible child like a tomb, and the severer the abuse, the longer the repression.

As long as he/she is determined to deny the facts, the aggressor's emotional life will freeze in the blur of his/her childhood humiliations.

What is the victim unaware of though? The only thing the victim is unaware of is the reason why he/she is hurting.

Thus, he/she comes to believe that he/she says and does something inappropriate/ unconsciously that determines the aggressor, (father/ mother/ professor/adults in general) to suffer just like he/she is.

The last thing the victim imagines is that these authority figures cannot look for solutions, because they do not share the same reality.

Victims will carry all through their adult life their childhood doubts, which will surface when, subjected to manipulations in their professional /corporate life, they accept to hear things that may provide them with an answer as to the cause of their own pain.

Although mature persons, the victims have not grasped the significance of the childhood pain. However, they keep in touch with the spirit in the center of their being, which construes the source of their personal power.

Psychologist ALICE MILLER explains that any return of the love/solidarity/ compassion will be useless as long as this crucial fundament of sympathy and understanding is missing.

The aggressor cannot feel for the victim's pain because he/she does not know how to be empathic, (this is due to the understanding of their own emotions and self-compassion).

The call for love/compassion towards fellow beings is not responded, since his/her actions derive from repressed feelings that determine him/her to punish his/her victims' weakness by dominating them as it happened to him in his/her childhood, which he/she believes to have deserved for having been weak.

In this compulsive conduct the aggressor in unable to get in touch with his/her feelings but will practice them on someone else.

Thus, the never revealed pain / insecurity / humiliation accumulated during his/her childhood continues to grow in the cold mechanism of rage and determines him/her to take revenge by perpetrating the abuse, at stake being the fleeting sense of power in dominating the victim.

Besides the deeply buried insecurity and inadequacy, the aggressor's mind also conceals feelings of guilt for having completely separated from his/her mother, through the rejection of the maternal model.

The Oedipus complex generates culpability in the mother-child relationship.

Relinquishing this guilt determines the aggressor to feel he/she has risen above the idea he/she rejected. He/she will despise everything related to the feminine sex in order to justify his/her separation from his/her mother and to minimize his guilt.

The aggressor denies a complex of correlated feelings and hence gets to the point of denying himself/herself.

Who is this aggressor, this person who has invented a new self-image, denying his/her own past? KAREN HORNEY's studies explain:

- If his fellow men were to define him/her, the aggressor would be hard to know by those around;

- If he/she were to define him/herself, the aggressor would describe him/herself as a person believing him/herself to be an ideal image.

The aggressor's self-assessment is not based on his/her feelings but is in fact the fragile construction of a mind that lacks personal power.

What is the personal power of an individual?

To live sensing/choosing/ creating from the depths of one's being, by becoming aware of one's emotions/ feelings represent the personal power of a man.

By dominating his fellow men, the aggressor seeks a status superior to them in order to avoid being discovered as an insecure / humiliated / blocked / ridiculed / impotent person.

The one committing the abuse hides behind his/her attitude feelings of insecurity / shame / fear / anxiety.

The ideal self-image of the aggressor denies his/her own motives/ compulsions / actions in any of the following ways:

- Although tense/upset/explosive, the aggressor will describe himself/ herself as calm and relaxed;
- Although critical and querulous, the aggressor will describe himself/ herself as tolerant;
-Although indifferent/defiant/cold, the aggressor will describe himself/ herself as an altruist/warm/ unconditional aid of his/her victim
- Although he/she is the one contradicting/ discarding/denying the values, beliefs and experience of those around him/her, the aggressor will declare himself/ herself open to perspectives other than his/her own.

In 1979 psychologist FLEMING mentioned in the specialty publications the results of his research, which proved that only strong personalities are capable of admitting their weaknesses and the mistakes they make.

These are the people who practice their self-confidence.

Someone who deep down believes himself to be weak /inferior, will not be able to do so and the aggressors are secretly very helpless people.

This is why they try harder and harder to deny their feelings, projecting them on those at hand, (from children and parents, to subordinate employees, generally on those who they should take responsibility for) and towards whom they ought to have duties by definition of the official position sought after in society, (family/ company) and which, unfortunately, they often come to fill.

As time goes by, aggressors become more and more reluctant in confronting themselves, out of fear of the painful feelings they would have to bravely face.

Their fear will encourage the accumulation of their fury and self-detachment in the secret corner of their being, which will, in turn, determine them to avoid introspection, thus becoming unable to recognize the source of these feelings.

When these feelings surface, the cause of discomfort is, to the aggressor, the victim. This is the projection. By projecting, aggressors accuse their victims of all their doings, blaming them for whichever abuses they themselves commit.

Why? Because this way the victim becomes what the aggressor once was, hurt and without no one to witness his/her pain. To the aggressors, the victims are merely an expression of themselves.

They see the victims, recalls their own dark feelings, their own vulnerability, all the feelings that "should have never existed" and which therefore must be controlled.

Thus, the victims of the abuse become the object of the aggressors' control and this control becomes the victim's oppression. Where there is oppression, there is projection and where there is projection, there is denial.

The aggressor is afraid of his victim, who represents his own insecurities/humiliations/ weaknesses as he is no longer able to display understanding/ empathy/communication skills or the ability to apologize /real preoccupation for the situation he finds himself in.

CONCLUSION

-What can the aggressor do?

He will spill his anger from his unaccepted/ denied feelings, indulging a sense of power by dominating, promoting his ideal image while he avoids acknowledging his actions, projecting his repressed feelings on his victim.

Thus, the aggressor's life becomes a battle against the victim who carries his projection.

This, as well as his sentimental side, should not exist. The aggressor cannot see it as it is, and is incapable of perceiving the victim's reality.

Every abuse is the aggressor's attempt to defend himself from the feelings of rage, fear, helplessness of the inner child and to protect himself from knowing his true attitude.

All those who seek the dominating power do it to defend and protect themselves from their own repressed feelings of personal impotence.

Things are not different in the case of authority figures in companies where empiric management is still applied. These incompetent superiors practice verbal abuse on their subordinates.

The feelings of impotence masked by the aggressor are replaced with a self-acclaimed superiority image, using the protection mechanism of either of the below:

1. A RESERVED ATTITUDE by which the victim is dominated with the purpose of maintaining the aggressor's ideal image.
2. CONTRADICTING EXPERIENCES / BELIEFS of the victim, the purpose of which is for the aggressor to protect himself of his own feelings of inadequacy and impotence.
3. BLOCKING/SABOTAGE by which interpersonal reality is controlled with the purpose of alleviating the aggressor's hidden feelings.
4. ACCUSATIONS/REPROACHES are symptoms of the projection by means of which the aggressor avoids the responsibility of his attitude and protects his ideal image by blaming the victim and making him/her responsible for his own feelings.
5. PERSONAL CRITICISM represents the aggressor's attempt to defend himself from his hidden feelings of inferiority and impotence, reinforcing his self-image by claiming his own superiority synonym with attacking his victim's public image.
6. HOSTILE JOKES, by means of which the aggressor aims to feel superior/strong, by blaming/exposing to ridicule/humiliation the victim before the latter would even realize it.
7. SLIGHTING, by disparagement/disdain the victim as a self-defense method against his own feelings of inadequacy /incompetence.
7. DENIAL by means of oblivion, with the purpose of avoiding taking responsibility for the hostility of his attitude and for his dodging, aiming to build his ideal image by maintaining his projection on his victim.

The aggressor does not wish to look into himself. This is his personal tragedy as well as the very cause why he will do what it takes to not acknowledge his shortcomings.

The victim of the verbal abuse in the military management of the corporation is the competent employee, subordinate/superior/ colleague, whose rights/expectations were violated/ignored in its psychological/legal contract with the institution, whereas he/she had done nothing wrong towards the employer but rather:

- Exercised discipline at the work place and respected the contractual obligations towards the employer/ company internal regulations/state laws or individual morality;

- Contributed to the improvement of the company image towards customers / providers by the professional competence he/she displayed and the fairness he/she applied in said affairs;
- Achieved professional performance compliant with the assessment criteria for measuring performance that were taken into account in the job specification;
- Displayed a devotion towards the cultures of the military corporation, enforcing them by his/her actions at the work place rather than simply reciting them.

BIBLIOGRAPHY

1. Kets de Vries, M., *Leadership, the Art and Mastery of Leading*, Condex Publishing House, 2003.
2. Goleman,D., *Emotional Intelligence*, Curtea Veche Publishing House, 2001.
3. Danile Goleman, Richard Boyatzis, Annie McKee, *Emotional Intelligence in leadership*, Cartea veche Publishing House, Bucharest, 2005.
4. Danah Zohar, *Spiritual Intelligence*, Radin Print Publishing House, Bucharest, 2011.
5. Karl Albrecht, *Practical Intelligence*, Publishing Curtea veche, 2007

ECONOMIC PERFORMANCE ASSESSMENT REGARDING AN FLEXIBLE MANUFACTURING SYSTEM INVESTMENT

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Abstract: *Economic efficiency of a manufacturing system variants are assessed annually by the additional benefit achieved by operating the system in question in relation to the reference system. Technical problems generally have many possible solutions. The choice between them is made on economic considerations.In the synthesis of a flexible manufacturing system is usually develop several variants of different solutions from a technical standpoint. The additional benefit is calculated annually taking into account on the one hand favorable economic effects are obtained by introducing relevant, increasing labor productivity, improve product quality, increase competitive ability of the enterprise, shortening travel times of a product, reducing capital asset , reduced labor costs, materials, overhead, on the other additional expenses related to the implementation and operation of the system.The economic evaluation of variations of flexible manufacturing system is usually done by comparing the economic efficiency of an embodiment an another or all versions of each core, which is usually have the „clasic" manufacturing system. Among them will be chosen to achieve that which is most economically advantageous.The article will present as a solution method amortization period of the investment. The basic idea is to follow the principle that the net profit generated by the investment in a flexible manufacturing system must ensure the depreciation in a given time period called for cushioning.*

Key words: *Flexible manufacturing system, net annual income, payback time, annual production, volume, total annual costs.*

1. INTRODUCTION

Flexible manufacturing system is a set of integrated computer controlled automated material handling equipments and numerical controlled machine tools capable of processing a variety of part types.

Due to the competitive advantages like flexibility, speed of response, quality, reduction of lead-time, reduction of labour, flexible manufacturing system are gaining popularity in industries.

The better the choice, more will be the productivity as well as the profit maintaining quality of product and responsiveness to customers.

Though FMS is an outgrowth of existing manufacturing technologies, its selection is not oft studied. It has been a focal point in manufacturing related research since early 1970s.

Flexible manufacturing system provides a low inventory environment with unbalanced operations unique to the conventional production environment.

Process design of flexible manufacturing system consists of a set of crucial decisions that are to be made carefully. if the operations are balanced, the environment becomes that of the transfer line. The changes in production are related to both inventory changes as well as changes in flow time. [1]

The selection of a flexible manufacturing system thus requires trading-off among the various parameters of the flexible manufacturing system alternatives.

The selection parameters are conflicting in nature.

Due to material and financial values that are involved, design, investment and subsequent exploitation of a manufacturing system must be based on rigorous economic criteria.

The fundamental problem you have always had in mind is finding optimal solutions, designed to ensure return on investment deadline and getting the benefits. [2].

Technical problems generally have many possible solutions. The choice between them is made on economic considerations. In the synthesis of a flexible manufacturing system is usually develop several variants of different solutions from a technical standpoint.

Among them will be chosen to achieve that which is most economically advantageous. As a comparison result for variants of the solutions should be valued in terms of economy considerations. The economic evaluation of variations of flexible manufacturing systems is usually done by comparing the economic efficiency of an embodiment of another variant in one or all of the core, which is usually have the manufacturing system "classic"[3,4].

Mustafa and Robert have also developed a knowledgebased decision support system suitable for short-term scheduling in flexible manufacturing systems and strongly influenced by the tool management concept to provide a significant operational control tool for a wide range of machining cells, where a high level of flexibility is demanded [5].

Economic efficiency of a manufacturing system variants are assessed annually by the additional benefit achieved by operating the system in question in relation to the reference system.

The additional benefit is calculated annually taking into account on the one hand favorable economic effects are obtained by introducing relevant, increasing labor productivity, improve product quality, increase competitive ability of the enterprise, shortening travel times of a product, reducing capital asset , reduced labor costs, materials, overhead, on the other additional expenses related to the implementation and operation of the system.

In the synthesis of a flexible manufacturing system is usually develop several variants of different solutions from a technical standpoint.

Among them will be chosen to achieve that which is most economically advantageous.

As a comparison result for variants of the solutions should be valued in terms of economy. Payback period method should be chosen solution.

2. METHOD

It talks about the net annual income of the investment made (V^n) which is the difference between revenues and expenses by selling finished products made of flexible manufacturing system to produce them [2].

We will consider three alternatives:

- (V^n <0). In this variant flexible manufacturing system is a "consumer money". It is not possible depreciation fincare investment and operating time, and we produce additional losses recoverable.

- (V^n = 0), where flexible manufacturing system does not allow recovery of the initial investment.

- (V^n > 0), representing the optimum desired.

If the additional annual amount of benefit obtained by running all versions of flexible manufacturing system will be negative, so it sees profit by implementing systems solutions proposed will be dropped - from economically - the implementation of flexible manufacturing system community.

Zero profit manufacturing system indicates the minimum annual production volume and minimal costs to economic performance for flexible manufacturing systems.

If $V^n > 0$ and is constant each year payback time in a flexible manufacturing.

$$T_a = \frac{90.000 Euro}{30.000 Euro / year} = 3 \text{ years for amortization} \quad (1)$$

T_a system- the number of years it will be the ratio between the initial investment and annual income:[2]

$$T_a = \frac{C_i}{V_n} \quad (2)$$

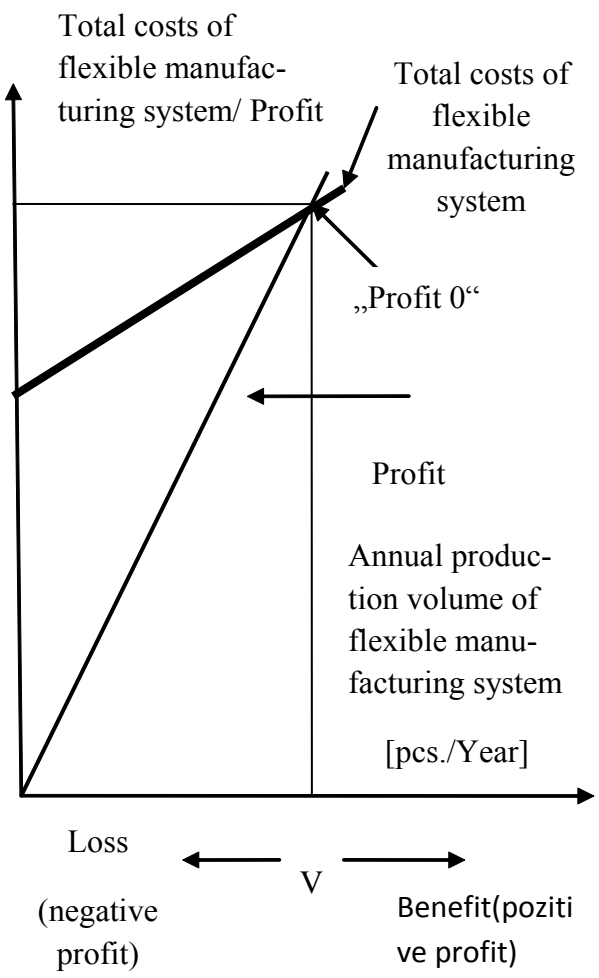

Fig.1. Graph of profitability of a flexible manufacturing system

3. STUDY CASE

An flexible manufacturing system costs 90,000 Euro annually, products worth 60,000 Euro, and the expences are 35,000 Euro.

It analyzes evaluating the investment opportunity of such a mechanism, designed to be kept in operation for 8 years. It will choose the flexible manufacturing system for the expected annual benefit will be maximized.

V^n = 60.000Euro/year - 35.000Euro/year = 30.000 Euro/year

$V^n > 0$, so the investment is amortized

According to Figure 2 the fixed costs are constant and do not depend on the volume of production. It is expressed in annual values.

Variable costs are directly dependent on the volume of production. In addition to the costs described must be considered and maintenance costs due to outdated equipment.

Costs due to wear are more difficult to estimate quantitatively and differ from one machine to another.

They grow linearly with the volume of production achieved, so the total cost of production will total fixed and variable costs. So all production costs for a flexible manufacturing system are divided into fixed costs (C^f) and variable costs (C^v).

Economic situations prefer a different classification of costs:

- personnel costs (wages, social security)
- material costs (raw materials and consumables).
- indirect costs or additional costs of providing business functionality
- indirect costs from factory (ensuring social conditions of labor, labor, transportation of materials, office with customers).
- indirect costs to the company (supporting research, commercial advertising, market research, specific taxes).

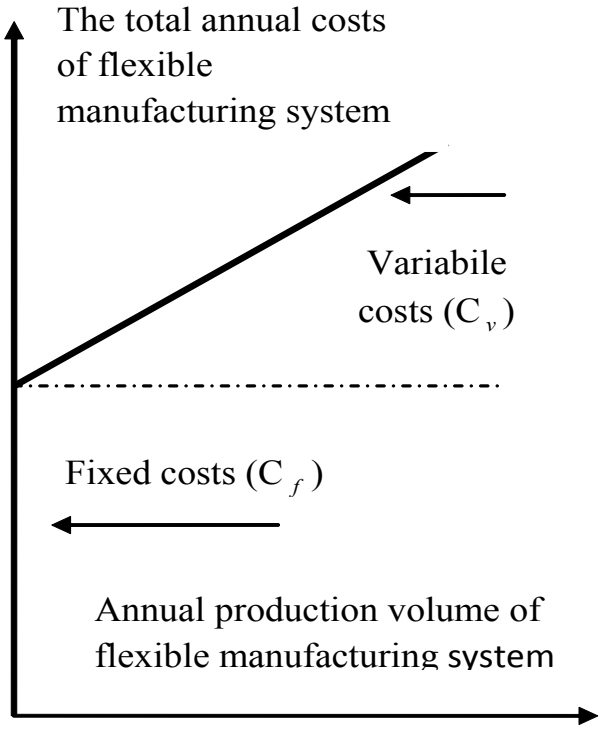

Fig.2. Ideal evolution of total cost

CONCLUSIONS

The economic criterion used in the economic analysis division is the added benefit annually by putting into operation of flexible manufacturing system in relation to manufacture in a classical system.

If the additional annual amount of benefit obtained by running all variants of flexible manufacturing systems will be negative, so it sees profit by implementing systems solutions proposed will be dropped - from economically - to implement the flexible manufacturing system.

The selection problem of flexible manufacturing system is complex due to the high capital costs involved and the presence of multiple profit criteria.

One can reduce investment and maintenance costs, increase equipment utilization, efficiency as well as improve facilities layout by selecting the right system suitable for the operations to be carried out.

For the flexible manufacturing system, performance standards of the systems are not uniform, and expression of capabilities and performance attributes among manufacturers are inconsistent and incommensurable.

Technical problems generally have many possible solutions.

The choice between them is made on economic considerations.

In the synthesis of a flexible manufacturing system is usually develop several variants of different solutions from a technical standpoint.

Among them will be chosen to achieve that which is most economically advantageous.

As a comparition result for variants of the solutions should be valued in terms of economy.

The economic evaluation of variations of flexible manufacturing systems is usually done by comparing the economic efficiency of an embodiment of another variant in one or all of the core, which is usually have the manufacturing system "classic".

The additional benefit is calculated annually taking into account on the one hand favorable economic effects are obtained by introducing relevant, increasing labor productivity, improve product quality, increase competitive ability of the enterprise, shortening travel times of a product, reducing capital asset , reduced labor costs, materials, overhead, on the other additional expenses related to the implementation and operation of the system.

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BIBLIOGRAPHY

1. A. Bhattacharya, A. Abraham, P. Vasant, *Flexible Manufacturing System Selection under Disparate Level-of-Satisfaction of Decision Maker using Intelligent Fuzzy-MCDM Model*, 2005
2. M. Nitulescu, *Flexible manufacturing systems*, University of Craiova, Romania, 1997.
3. I. Abrudan, *Flexible Manufacturing Systems - Design concepts and management*, Cluj – Napoca, Dacia Publisher, 1996
4. G. Cojocaru, F.R. Kovacs , *Robots in action. Problems of synthesis of flexible manufacturing systems,* Timisoara, 1986.

NEW DIRECTIONS IN LANGUAGE ACQUISITION: MISCOMMUNICATION

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Abstract: *The aim of this paper is to provide a contrastive analysis of two articles relative to the matter of "miscommunication". In this respect, Jenny Thomas's "Cross-Cultural Discourses as 'Unequal Encounter': Towards a Pragmatic Analysis", from a revised paper presented at First Annual Workshop on Pragmatics and Second Language Acquisition, Toronto , Canada, March 1983 and Srikant Sarangi's "Accounting for Mismatches in Intercultural Selection Interviews", from Multilingua 13, 1-2, 163-194, 1994 will be focused on. Mention should be made at this point that manifestations and evidence of 'miscommunication' in both articles involve only non-native speakers, in their social encounters with native users of English. The chronological distance between the years of publication of these two articles may, again, be of relevance when judging the authors' standpoint towards the topic of "miscommunication".*

Key words: *miscommunication, metapragmatics, intercultural communication, discourse analysis*

1. INTRODUCTION. SUMMARIES OF ARTICLES

1.1. Jenny Thomas: *Cross-Cultural Discourses as 'Unequal Encounter': Towards a Pragmatic Analysis.* Jenny Thomas, in the beginning of her article, makes reference to two of her previous strands of research, respectively, the first dealing with the pragmatic aspects of cross-cultural miscommunication, and the second with the language of asymmetrical discourse ('unequal encounters').

The author argues that the pragmatic force of a non-native speaker's utterance may not be what the speaker intended if he or she adopted forms which, in English, are used by dominant speakers only. Furthermore, Thomas focuses particularly on the way English is used by Soviet citizens who have little contact with native speakers of English and who, despite their good command of the language, appear domineering due to some discursive features existent in the Russian language.

Three metapragmatic acts are then identified by the linguist in the speech of Soviet speakers of English, which may explain their 'dominance' in speech acts.

These are the Illocutionary force Indicating Devices, the Metapragmatic comments and the 'Upshots' and 'Reformulations'.

The common point of these features is that, by using them, the dominant participant impedes interlocutors from having any possibility of taking refuge into the "pragmatic ambivalence", that is, leaving the illocutionary intent of the utterance 'diplomatically' unclear (Thomas: 227).

The coined phrase of 'unequal encounters' includes, in Thomas's perspective, discursive relationships between a dominant participant and a dominated one: for example, between a teacher and a pupil, a police officer and a suspect, a judge and a trialed person etc.

The inappropriate use of illocutionary force indicating devices and metapragmatic acts may be an indicator of pragmatic failure when a non-native speaker uses in L2 a structure which is semantically or syntactically equivalent to the L1 structure but has different pragmatic force in L2 (Thomas: 231).

This would explain why utterances intended to be requests for information about the linguistic meaning of a native speaker's utterance might be taken as challenges by the latter.

In conclusion, the existence of unmarked forms in L1 risk to appear as marked for '+ power' forms in English due to misinterpretation of L1 illocutionary force indicating devices and/or metapragmatic acts.

1.2. Sarangi, Srikant**:** *Accounting for mismatches in intercultural selection interviews.* In this article the author examines the strengths and weaknesses of two explanatory frameworks: Levinson's (1979) 'activity type' and Gumperz's (1978, 1982) 'discourse strategy'. The author compares these two analytical frameworks to show the differential treatment of evidence of miscommunication. His standpoint differs slightly from the cited linguists in that he considers that while one framework (activity type) does not take into account the cultural component and the individual choices, the other framework (discourse strategy) pays little attention to the rule-governed nature of the immediate communicative situation. In his attempt to demonstrate the role which cultural background plays in mismatches occurrences, Sarangi focuses his attention on the selection interviews in the intercultural settings.

Examples are provided to illustrate his viewpoint.

In the next part of the article, the author examines linguistic breakdowns caused by different cultural assumptions (for example, the Asians' way of answering questions in an indirect manner, starting from the general and going to specific information, since a very direct answer is considered inappropriate or impolite in their culture). In Sarangi's acceptance, nevertheless, cultural difference should not be used as an excuse for deviated answers.

The authors believes that the interviewees' consciousness related to the formal framework of an interview taking place in a setting different from their native one should be taken into consideration at all times and it should be the non-native responsibility to become aware of such realities.

The author concludes by saying that in both frameworks 'culture' is perceived as a fixed entity, despite of the dynamic aspect of the 'culture mix'.

He mentions on the other hand that 'intercultural communication is as much about miscommunication as it is about communication and that researchers should continue to account for mismatches and breakdowns since they offer insight in the process of intercultural communication.

2. CLAIMS

The claims of these two articles appear to be both theoretical and empirical, given the fact that the articles are dual in their nature. The theoretical feature owes to theoretical references employed by both authors in their attempt to justify a new or different position relative to the topic in discussion whereas the empirical characteristic is awarded due to research made by authors and their findings as a result of this research.

Consequently, Thomas claims that 'unequal encounters', in terms of dominant and dominated participants, exist due to a misinterpretation or ignorance of cultural manifestations in L1, while Sarangi claims that mismatches in intercultural selection interviews occur due to superficial engagement in understanding L1 users, on the part of the interviewers, on the one side, and an unawareness of the interviewees with regard to both their 'rights' and their commitments. The common point of these claims would be the role of the cultural features in the native – non-native encounters and the existence of the dominant position assumed by the native speakers in their relationships with non-native interviewees.

3. PERSPECTIVES ON CONCEPTS

Thomas and Sarangi share a common viewpoint with regard to the importance of taking into consideration L1's cultural and pragmatic features. Both authors attempt to justify their new perspective on the topic of 'miscommunication' starting from a general, theoretical framework – citing the works of other authors involved in the same endeavor, and later on making reference to their empirical finding and illustrating their assumptions with conclusive examples (samples of interviews are provided for illustrations).

The difference in perspectives is given mainly by the focus of the authors' approaches towards intercultural mismatches: for Thomas, the pragmatic aspect of L1 is more important, whereas for Sarangi, the analytical apparatus researchers use to identify occurrences of miscommunication and how precise their argument is as to what linguistic and contextual factors contribute to that miscommunication counts more. Again, both authors add their personal interpretation or findings to the already existent theories in the area of miscommunication.

4. POSITIONS IN RELATION TO OTHER AUTHORS

Jenny Thomas continues her theoretical assumptions expressed in her previous papers, relative to the pragmatic failure (Thomas 1981, 1983a, 1983b). She agrees with the findings of the researchers at the University of Lancaster engaged in the treatment of 'unequal encounters'. However, different from them, Thomas concentrates her attention on "those pragmatic discursive strategies employed by the "powerful" participant in an interaction and which seem to enable him or her with the clearest examples (…) of the way they operate, taken from a variety of unequal encounters" (Thomas:227). Furthermore, she cites many linguists dealing with the theory of 'pragmatic use' of the language and applies such theoretical perspectives in order to demonstrate pragmatic failures. There is no evidence, in this article, of her denial of previous concepts from other authors, it is only a clearer explanation of how theoretical concepts function in her illustrative examples (i.e. videos of interviews).

Srikant Sarangi bases his theoretical approach toward mismatches in intercultural selection-interviews on the previous findings of Levinson's and Gumperz's mainly, although he does not totally agrees with their theories. Sarangi finds some shortcomings of Levinson's notion of 'activity-type-specific behavior, namely, that "it may appear a difficult proposition particularly in the intercultural situation where there may not exist a set of norms which could be taken as given by both parties (…), therefore, Levinson's notion of 'activity-type' has to be recast as a more flexible construct." (Sarangi:185).

Gumperz's view of 'rhetorical strategies' will be further considered in Sarangi's detailed discussions of 'shared rhetorical strategies' in the job interview setting (Sarangi:189), and will open up "a hitherto neglected aspect of intercultural communication studies for further scrutiny: intercultural communication is as much about 'miscommunication' , as it is about 'communication'" (Sarangi:190).

5. METHODOLOGY

As mentioned previously, in this paper, both articles under analysis combine the theoretical consideration with empirical findings. Nevertheless, although there is indication of the methods used to collect data, specifically, interviews and videos of interviews, there is not a clear indication in terms of number of interviews, number of participants involved in interviews, which is, information regarding the sample to be analyzed. Readers of these two articles may imply that, both authors (already known in the area of linguistics and pragmatics) are cognizant of the research requirements (i.e. a valid sample, research questions, valid interpretation of data etc.), therefore, may take for granted the validity of their claims and interpretations.

From the readers' perspective, the examples provided by both authors to sustain their claims are enlightening, whereas the explanatory theories come to help readers understand better the topic under discussion.

The interpretation of findings, thus, leaves no place to ambiguity, since it is sustained by both theoretical and practical support.

6. TYPE AND STRUCTURE OF ARTICLES

Both articles under consideration are theoretical, in essence, but provide empirical evidence. Their structures appear almost identical, also: they begin with an introductory part in which the authors give justification for their writing, although in Thomas's case, there is not a clear mentioning of the 'introduction' paragraph.

Furthermore, the content of the articles pursue the logical sequence of argumentation and even a common pattern: theoretical approaches (the authors' and others') followed by illustrative examples, that is, going from general to particular. Conclusions, in both cases, come to strengthen the claims and to draw attention on the personal contribution of the authors. In terms of length, Thomas's article is shorter and makes reference to her previous paper related to the same subject matter, yet, the shortness of the paper does not impede understanding on the reader's part and the claims are sustained in the end. Sarangi's article, on the other side is ampler and tries to cope with every possible aspect of the topic and to support the initial claim with pertinent examples.

7. STYLE AND LANGUAGE

The style adopted by the authors is the direct one, in both cases. The personal style is reflected by the use of first person singular, even though, in Sarangi's case, the mentioning of the plural "we" suggests the writer's inclusion in a research team dealing with the same topic. The language of the articles is given strength by the use of the present tense, which is an indicator of the pertinence of the claimed (and sustained) theories.

8. FURTHER RESEARCH

In the beginning of this paper there was mentioning of the distance between the times when the articles had been written: approximately ten years. Therefore, in Thomas's case, further research might have become 'previous theories' to Sarangi. Anyway, both writers agree that the research they have been involved in, is still far from being ended up and they both welcome new approaches to the apparently endless subject of interculturality when it appears to be the reason for miscommunication.

CONCLUSIONS

Given the notoriety of the authors involved in this analysis in the field of linguistics and pragmatics, a student, considered to be a novice in the area of language theory, may only benefit from their research. From a personal perspective, their articles have come to enlighten the intricate facet of miscommunication from a different standpoint: that of the intercultural approach, thus, benefiting further understanding of the reasons that may produce such mismatches, apart from miscommunication produced by the poor use of linguistic devices or inappropriate language behavior.

BIBLIOGRAPHY

1. Gumperz, John J., Levinson, Stephen C. – editors (1996), *Rethinking Linguistic relativity,* part of *Studies in the Social and Cultural Foundations of* Language, Cambridge University Press
2. Sarangi, Srikant (1994), *Accounting for Mismatches in Intercultural Selection Interviews,* in Multilingua - Journal of Cross-Cultural and Interlanguage Communication. Volume 13, Issue 1-2, Pages 163–194.
3. Thomas, Jenny (1983). *Cross-Cultural Discourses as 'Unequal Encounter': Towards a Pragmatic Analysis,* from a revised paper presented at First Annual Workshop on Pragmatics and Second Language Acquisition, Toronto , Canada.

AEROTITIS MEDIA

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Abstract: *Aerotitis media (otitic barotrauma, barotitis) is an acute or chronic pathological condition caused by the pressure difference between the ambient air and that of the middle ear. It is the most common otitic disorder among flying personnel today. Under normal conditions this equilibrium is dependent on Eustachian tube function. During ascent, the air expand in all facial structures including the middle ear. Because of excessive pressure on the tympanic cavity, middle ear pressure equalizes and the tympanic membrane snaps or "clicks" into its normal position. During descent from altitude, when the atmospheric pressure increases, a totally different effect is produced. At the momennt, Eustachian tube dysfunction (ETD) do not have a consensual treatment. The peculiarities of anatomy and physiology of this structure can be the cause. This paper shows the history of medical efforts in aerotitis, with the corresponding moments of success or disappointment.*

Key Words: *Aerotitis media, Surgery, ENT.*

1. INTRODUCTION

Various symptoms and disease states have been attributed to abnormal obstruction of the ET, also called ET dysfunction (ETD), including aural fullness, tinnitus, serous otitis media, tympanic membrane retraction, and cholesteatoma.

The effective treatment of these common disorders has challenged otolaryngologists for centuries, and continues to consume substantial resources. Recent advances in endoscopic techniques have brought a renewed interest in the ET as a surgical target. Although several new surgical procedures have been proposed, the ideal treatment for ETD remains to be determined. Prior to the availability of nasal endoscopy, a variety of attempts were made at surgical treatment of
ETD, most of which were ultimately in vain. In seeking to develop new techniques, it is often instructive to consider the past history. Therefore, in this article we review the history of ET surgery, with a focus toward identifying factors that may have promoted or hindered successful outcomes .

2. ANATOMY

One of the earliest descriptions of the pharyngotympanic tube was made in the fourth century BC by Aristotle, who believed that it carried echoes from the ear to the heart.

The Italian anatomist Bartolomeus Eustachius, who is credited with recording the first work to deal exclusively with the ear, accurately described the course and relations of this structure in 1562. Writing in Epistola de Auditus Organis, he divided it into bony and cartilaginous parts lined with a mucous membrane. In 1683, Duverney corrected an age-old misconception by proposing that this structure served as the channel through which the air of the middle ear was renewed, rather than an avenue for hearing or respiration.

The name of Eustachius was ascribed to the structure in 1704 by Antonio Valsalva, who discovered the muscular attachments at the pharyngeal orifice.

Valsalva believed the ET was a conduit for expelling pus in cases of otitis media, for which purpose he developed the maneuver that bears his name.

Three hundred years of investigation has enhanced our understanding of ET anatomy. The ET has a reported length of 31 mm to 38 mm, of which approximately the medial two-thirds is lined with fibrocartilage and the lateral one-third is within the temporal bone. Three-dimensional modeling has demonstrated an hourglass-like central constriction, referred to as the isthmus, near the junction of these segments, which may be as narrow as 0.65 mm2 cross-sectional area.

The cartilaginous portion is obliquely angled and is composed of anterior and posterior laminae. The anterior lamina provides an insertion for the tensor veli palatini muscle approximately 12 to 20 mm deep to the pharyngeal orifice. The result is a valve-like region which, assisted by other peritubal muscles, produces a coordinated sequence of dilation that has four distinct phases. Abnormal closure of this valve is believed to underlie the majority of cases of ETD.(fig1)

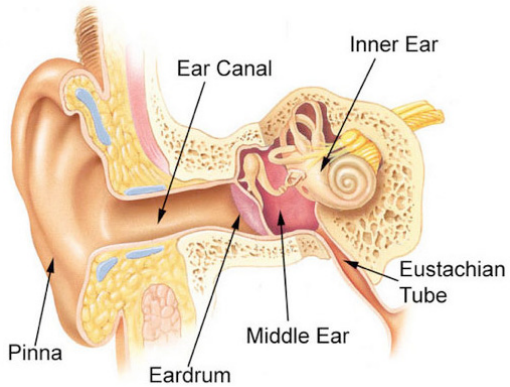

Fig 1 Eustachian tube - anatomy

3. IRRIGATION AND INSUFFLATION

In 1724 Guyot performed the first surgical intervention on the ET by oral approach utilizing a curved surgical tool across the soft palate.

Seventeen years later the nasal approach of the ET was depicted in by Archibald Cleland. His successors described in detail, based on cadaveric study, the process of catheterization and tympanic irrigation to expel the ‘‘excrementous matter’’ in the middle ear.

Topical application of adrenalin and silver compounds to the pharyngeal orifice was also occasionally employed.

Itard was the first physician who presented the ET tubular medical device for insufflation as a manner of therapy for otitis. Cases of otitis that did not respond to catheterization, irrigation or insufflation were subjected to more forceful measures. A variety of bougies and dilators were developed by French and German otologists to promote patency of the ET. These instruments were typically made of catgut, whale bone or semiprecious metals. Kramer described the transnasal insertion of a catgut bougie into the ET, which would be left in place to be removed by the patient several hours later. ‘‘The massage of the mucosa and musculature’’ of the ET and ‘‘its stimulating effect both on the circulation and on the peripheral nerve endings’’ were cited as favorable benefits of serial dilation. Metallic bougies were also developed that could conduct a mild galvanic current, which was believed to enhance this salutary effect on the ET tissues.

4. FAVORING THE EAR

Prior to the 19th century, the primary interest of otologic surgeons was acute intervention for suppurative mastoiditis.

A new era for otology arrived when, in 1800, Sir Astley Cooper performed the first deliberate myringotomy for the remedy of deafness. Cooper suggested that this new surgical procedure was a viable treatment option for ‘‘deafness that arises from an obstruction of the Eustachian tube.’’

Step by step, the acceptance of myringotomy had all but forced ET catheterization into obsolescence. Nineteenth century interventions of the ET were predominantly transtympanic. The radical mastoidectomy procedure, so common in the preantibiotic era, was often considered incomplete without transtympanic obliteration of the ET to prevent the passage of infectious matter from the pharynx. Meanwhile, the function of the ET continued to inspire debate. Muller stated that the ET was continuously open; Toynbee claimed it was closed except in the act of swallowing. In any case, the intent of all interventions was the restoration of a static state: either open to permit aeration or closed to bar the entry of infection.

The nature of the ET as dynamic organ remained entirely unappreciated. Surgical incisions of the pharyngeal ET were rarely considered during the latter 19th century.

One observer of the day, drawing a parallel to general surgery, noted that ‘‘no one has attempted to extend the treatment of strictures by incision to stenosis of the Eustachian tube.’’

In the 20th century, the lay and medical presses were dominated by reports of nonsurgical ‘‘reconstruction’’ of the ET for the cure of deafness using only an unaided finger, although these claims were ultimately refuted.

At least one description exists from this time of transoral surgical closure of the ET at the pharyngeal orifice. In the operation described by Thomas Halsted, an endoluminal incision was carried to the bony isthmus, after which the mucosa was stripped medially to completely denude the cartilaginous ET and produce fibrotic atresia. This was considered only as a salvage technique, and, with rare exception, surgery of the pharyngeal ET remained unpracticed until late in the 20th century.

5. STATIC STRUCTURE

Tympanoplasty was an other successful step of this kind ot treatment. Zollner described the technique for passing a silk thread through the ET during tympanoplasty to permit delayed packing removal. Later, he implanted a cannula that could allow middle ear insufflation and preserve ET patency through tamponade. However, no proposal for valvular control was made, and the method was tested only on cadavers.

A limited number of operations were performed, and late extrusion of the tube was typical in tympanomaxillary shunt. Local radiotherapy was also applied to produce direct mucosal irradiation in an effort to reduce ET inflammation.

In 1955, Beck developed a strontium–yttrium bougie for this purpose, and published favorable results for posttreatment ET patency, although long-term effects of this treatment remained speculative.

6. DYNAMIC ORGAN

The proliferation of fiberoptic endoscopy in the late 20th century has facilitated study of the nasal cavity and nasopharynx. Enhanced optics and video technology have allowed direct observation of the valve-like function of the ET pharyngeal orifice, and several reports have described the dynamic anatomy of the ET, particularly the contributions of peritubal musculature. Interestingly, endoscopy of the ET lumen has been available since 1976, when first reported by Yamashita. Aside from experimental efforts, however, a practical application for this technology has yet to be described.

Other pathways approach in ET surgical pathology has been presented by Kujawski so called Eustachian tuboplasty and by Metson. Recently, Yanez has demonstrated a laser tuboplasty with notable-term medium results. Although all of the operations described thus far have sought to relieve obstruction of the ET, the disorder known as patulous ET bears brief mention. Patulous ET most commonly presents with autophony, although accurate diagnosis may be challenging. Because patulous ET has only recently been considered a distinct entity, the evolution of its treatment is brief. In 1974, Misurya proposed a procedure to lengthen the tensor veli palatini, which was carried out by release of the muscular tendon from its course around the hamulus. A similar result was attempted through pterygoid hamulotomy.

Transtympanic silicone plugging has been advocated, as has ligation of the pharyngeal orifice and injection of botulinum toxin into the paratubal muscles.

Poe has described the endoscopic placement of a cartilage graft into a submucosal pocket within the tube lumen to restore normal valve competence of the ET. Due to small case numbers, conclusions about the effectiveness of any particular treatment are limited. Having reviewed the historic record, the wide variety of interventions that have been proposed for ETD is apparent. One is reminded of the repertoire of techniques available for tonsillectomy, which exists because an ideal technique remains to be discovered.

The results of each historic procedure have been limited by either the unsuccessful relief of symptoms or the risk of unacceptable adverse effects. Procedures that entailed drilling the bony ET placed the carotid artery at unacceptable risk. Surgical alteration of the peritubal muscles jeopardized normal swallowing function.

The blind insertion of catheters and other surgical instruments may have traumatized the ET lumen mucosa and contributed to scarring and ultimate treatment failure.

Moreover, as with other historic studies of surgical intervention, the reporting of outcomes has rarely been held to rigorous standards. Catheterization sought to address pathology in the middle ear, rather than within the ET itself. Dilation and drilling of the bony ET presumed that stenosis at the narrowest anatomical segment was the site of the lesion. Shunting procedures relied on the supposition that the ET was simply a passive conduit. It is worth noting that although medical therapies for ETD are widely practiced, their effectiveness remains uncertain. Several factors contributing to physiologic obstruction of the ET have been proposed, including allergic rhinitis, sinusitis, adenoiditis, and extraesophageal reflux.

Accordingly, patients diagnosed with ETD have been treated with antihistamines, topical and systemic decongestants, intranasal corticosteroids, antibiotics, mucolytics, and proton pump inhibitors.

Despite anecdotal successes, high-quality data for these measures is lacking. In this light, a reliable surgical therapy would be particularly beneficial. Potential avenues for the future of ET surgery include tubal endoscopy, balloon dilatation, endotubal stenting, and image-guidance technology.

CONCLUSIONS

Aerotitis media is the most common otitic disorder among flying personnel today. Although ET surgery has a lengthy history, the development of effective interventions is still in its infancy. Historic attempts to irrigate, obliterate, or bypass the ET overlooked the complex physiologic role of this dynamic organ.

Minimally invasive endoscopic techniques are now under investigation, enabled by the armamentarium of the rhinologist. Although the ideal treatment remains speculative, recent advances in the understanding of ET function have brought us closer to the effective management of this common disorder.

BIBLIOGRAPHY

1. Bluestone C.D. Otitis media, atelectasis adn eustachian tube dysfunction. Pediatric Otholaryngology 1996; 400-415.
2. Gates G.A. surgery of ventilation and mucosal disease. Otologic surgery 1994; 90-95.
3. Yanez C. Cross-hatching: a novel technique for Eustachian tuboplasty. Preliminary report. Otolaryngol Head Neck Surg 20113;142:690–691.
4. Morris M.S. Tympanostomy Tubes. Otolaryngolol Clin North Am 1999 386-387.
5. Tos M. Experimental Tubal Obstruction. Acta Otolaryngol 1999 55-60.

THE PRESENCE OF MILITARY STUDENTS TO SCIENTIFIC MANIFESTATION OF MILITARY HIGH EDUCATION

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Abstract: *Finding military student medicine- between scientific participants in the area of training is an act of integration and responsibility for preparedness future,, mastery '- medicine. In this context, this was in the military higher education scientific events to ,, my gun is the stethoscope 'encode and then decode direct involvement in their chosen field, to be always ready to respond,, now' and fulfilling all responsibility and professional ethics, mission.We believe that such a presence is beneficial because it shows that specialization and honors brings honor student body of troops, leading on recognizing the value of military medical professional.*

Keywords: *research, medicine, military student, involvement, performance.*

1. INTODUCTION

The entire structure, student of military medicine, encode attitudes and behaviors that make him to be 'different' than the rest of Medical, even if the reference community accepts them and recognizes the value.

Thus, starting from the motivation and ending with applications made, Military Medical education a route that combines the two 'arms' - stethoscope and instructions, which cause virtually consolidation of a military elite in higher education.

In this context, their presence not only in seminars, courses, groups and years of study, making landmark military medical students and attitude by recognizing outcomes and their value relative to the specific identity, all grafted on work and theirrespect .

To combine, correlate and maintain the balance between military training and civilian medical students during the teaching, the benchmark capacity maturity, consistency and accountability of this group of student soldiers.

Therefore, their presence in the 'city' - University of Medicine and Pharmacy Targu Mures, is not only beneficial, but especially enlightening in terms of moral and ethical qualities manifested mostly due first and last all training, but especially military student status medicine- evidenced by the results obtained in the years of study, a special occupying it involve their participation in scientific their weapon - stethoscope.

If in some studies, such as Pasca MD (2012) result that the psychological profile of these student moral and motivation of the choice of weapon, decode certain specific cognitive structures, their presence in scientific higher education students in recognizing the value it represent military their colleagues reported the weapons, she happily completing such participations in the medical higher education across the country, over the years of study.

Also, as a recognition and plan of research at military higher education, starting with the academic year and so far 2010/2011 Military Medical students are actively involved in the scientific sessions of the students:

- SECOSAFT - Land Forces Academy "NicolaeBalcescu" - Sibiu

- AFASTUD - Air Force Academy "Henri Coanda" - Brasov

their results are worth it, and not only by the number of participants, but especially the themes addressed in his research, demanstrand in this case both intellectual capacity, but mostly, cognition, creativity and openness to new concept, areas and modes of expression.

For example, the idea of "diversity in unity" allow us to present "cards" of scientific papers at student events mentioned above and that their value were rewarded with seats one and two in editions: 2010/2011; 2011/2012; 2012/2013 and 2013/2014.

It is time to note the beneficial and constructive way that students approached the topic military Medical, focused entirely on cognitive components of military life bringing more value and recognition of such activity field.

In this context, the edition of the academic year 2010/2011 SECOSAFT - Land Forces Academy,, NicolaeBalcescu 'Sibiu, LC and FE students in Medicine - specialization of Military Medicine, IV year, the work,, medical student personality characteristics military 'have proposed to realize the psychological profile of the student of first year Mg- MM, before, during, and after the first winter session, focusing on its attitude against the act of learning.

The results of the questionnaire applied after, but especially conclusions highlight that:

•Importance given that landmark study with high school work is not a measure of academic success.

•Personal satisfaction as a learning activity has been replaced by the lure of the first semester of a student when,, extra academic 'matter;

•Student of I-II face learning time management but with the way examined.

•Raise the capacity of self-learning and organizing the actual act.

The study revealed that students positively have realized that there have this problem so that in the shortest time-summer session - to find their own remedy by implementing effective learning style, bringing them results.

Also on SECOSAFT-but 2011/2012 academic year, continuing the footsteps of the first participation at this level Military Medical students in such higher education scientific of military students IA and CL of specialization General Medicine Military Medicine - Year II supported the work,,pedagogic relationship - for military medical student 'which highlighted the complex relationship, durable and professional that is established between time and studentmilitary teaching medical knowing that it is necessary to be a balance between the two identities necessary for success in both careers, medical and research militara.

The study results surprised that there is a correlation between the curriculum and the military training, differences can be found in optical,, years I. and II. and the final year V and VI, who want a deeper military study, the idea of binding theory plus practice.

At however conclude that surprised strategy whereby medical and military training while shaping the personality of the student, satisfacandu- i so desire to become officers and balances fundamental link between the careers of doctors and military.

This paper was established in an extensive article published in the journal AFT vol.XVIII No.3 (71) Trim III .2013, pag.294-301-Ed. Academia,,NicolaeBalcescu Land Forces', Sibiu.

The same work collectively IA and CL III.in year 2012/2013 year, had all the, SECOSAFT, undertook an interesting study and appreciated receiving,, motivation for choosing a military career by girls' starting statistically from that in the last five years, the number of female students opting for higher education as military, increased.

Interesant is stated that at the time of the study (2012/2013) of military higher education institutions AFT Sibiu, Brasov AFA , AFN Constanta, ATM Bucharest, Bucharest Tg.Mures MM-like respondent, representative sample consisted of 345 students.

The analysis of the results shows that:

•42% of respondents from military high schools.

•38% and follows military tradition in the family.

•94% feel able to pursue a military career proving 100% that they are suitable for the chosen weapon.

•97% want to pursue a military career, touching and so order the military by choice

Also, as a conclusion, the paper highlighted the fact that:

•Increasingly more girls opt for a military career, demonstrating that occupy leadership positions and excel in some areas, much better than boys.

•The motives choice made primarily relate to the benefits that they can get behind the choice of a military career.

•Girls are just as competent as boys, in terms of intellectual and a joint team, can guarantee success.

The edition of the academic year 2013/2014 at SECOSAFT -Sibiu, EV and TV students from Medicine - year specialization Military Medicine II, present the work, chronobiology military student life ', that aims to identify the involvement of students living biorhythm soldiers coming from different weapons.

Remark undertaken have revealed the influence of intrinsic and extrinsic factors on the daily activity of the organism under investigation, chronobiology program connotations, both individually and colectiv.In conclusion, the paper draws attention to the fact that, based on schedules, planning, programs of study and outcomes expected in certain areas of activity, cronobiologiei must be given due importance so that those involved will be high efficiency.

At AFASTUD - Brasov 2013/2014, IA and CL students - Year IV of Medicine - Military Medical specialization are present to accept student work,, family in military medicine, targeting career ', from the clever words of Father Theophanes, Metropolitan of Moldova and Bucovina to remember that,, family is just as important element for national security and military bodies', which structures the similarity in two complementary identities.

Based on these objectives:

•The importance of the family for military student medicine

•The existence and maintenance of family

•Family involvement in the choice of career / military medical specialty,

results revealed that the family remains the basic unit of society,, 'remarcadu also being that it is preferable that,, half' be all military framework, thus eliminating misunderstandings regarding the work program.

The findings come to certify the results so even if it needs some professional sacrifices the family has a future is founded on the principle of moral, especially the need to cultivate it among the military, being maintained, strengthened and maintained as a eternal flame.

Under these auspices, the work presented by the students of Military Medical Sciences Humanities compartment whole happily, their psycho-moral profile, which can certify for the future: certainty, responsibility, fairness, commitment, consistency, and especially honor ,, serve my gun is ... stethoscope '!

BIBLIOGRAPHY

1. Pasca MD (2007)- Consiliereapsihologica in mediuluniversitar , Ed.University Press ,Tg.Mures;
2. Pasca MD - Identification of motivational logistics in choosing the specialization ,,Military Medicine '' by the student – publicat in Review of the Air Force Academy Brasov , Romania , vol.X , nr.1(20)/2012 , pag.127-133;
3. Pasca MD , Iacob A, Coca L.-Teaching time – military medical student-publicat in RevistaAcademieiFortelorTerestre – Sibiu ,Romania , vol.XVIII , nr.3(71)/2013 pag.294-301 .

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When editing the articles which are to be published in the review some rules will be respected as follows:

The whole paper must be written with no free space between lines using the Times New Roman CE; the margins of the text: Top – 28 mm, Bottom – 20 mm, Inside – 25 mm, Outside – 20 mm, Header – 18 mm, Footer – 15 mm, Mirror margins activated, Paper format A4 210x297).

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Papers must be prefaced by a brief abstract in English up to 250 words. The text will be written in 11 pt high, Italic, justified, left-right alignment. A number of maximum 8 keywords will be written 11 pt below the abstract. The words will be 11 pt high, Italic, left alignment, separated by a comma.

The text of the paper will be written in English two free spaces below the keywords divided into two columns separated by a 5 mm free space. The characters will be 12 pt high, justify (left-right alignment). The main parts of the paper will be introduced by numbered titles with Arabic figures and printed in capitals, font 12 pt, bold, centered. A free space will be left above the text and another one below it. Paragraphs will be 6 mm indented.

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