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THE DRIVELINE ANALYSIS OF HYPER SUSTENTATION DEVICES

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Summary: *The flaps is a device used for the expansion of the hyper sustentation flight envelope. The flaps kinematics driveline control mechanisms require a dimensional study by dimensional parameterization kinematic rods and bearings used. This paper presents an optimized driveline analysis of the flaps control.*

Key words: *flaps, driveline, kinematics analysis, depending on the position.*

1. INTRODUCTION

The flaps is a hyper sustentation device placed usually at edge of the wing (aerodynamic surface) which works on the voucher principle, see Figure 1.1. The flaps role is to increase the coefficient lift by changing the local geometry. The flap actuation leads to a change in curvature of the wing that will produce an increase in lift at the same speed or a reduction in the constant incidence rate.

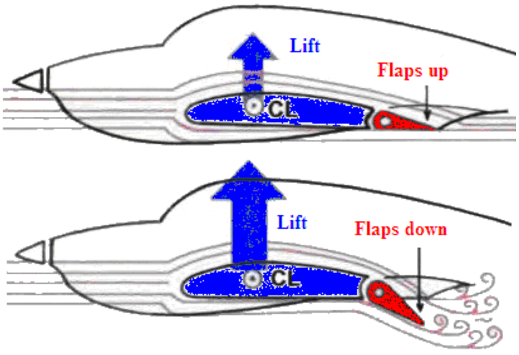

Fig.1.1 The effect of operating flaps

A series of papers [3, 5, 11] presenting the type of flaps highlighted in Figure 1.2.

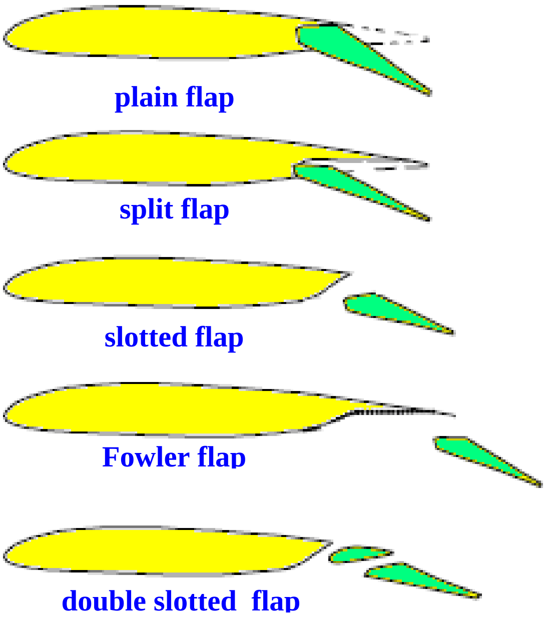

Fig. 1.2 Types of flaps placed on the edge of the wing

Fig. 1.3. Flaps down Cessna 172

Fig. 1.4. Flaps down L-29 Delfin [4]

According to the papers [8, 9, 10] the introduction of smart materials and system drive control surfaces define the concept of morphing (biologically inspired) which deleted the joints, the structure of the bearing surfaces being flexible.

2. KINEMATIC ANALISYS

2.1. Defining the components

The kinematics of mechanisms from command driveline of the flaps requires a rigorously dimensional study to prevent buckling phenomena and reduce the friction and the kinematic parameterization games in the rods and bearings.

The flaps actuator transmits force and motion in the powertrain, which includes sticks scenes and kinematic coupling elements with different degrees of freedom [1].

The voucher command includes a number of constructive landmarks, such as the control lever assembly, support for indexing, control rods, bearing assembly, lever assembly, damper, fasteners (screws, nuts, washers, split pins), [2]. In Figure 2.1 is shown a rigid driveline (plan) for actuating the flap, where B is the retracted position of the flap (0^0) and the flap position is removed (25^0).

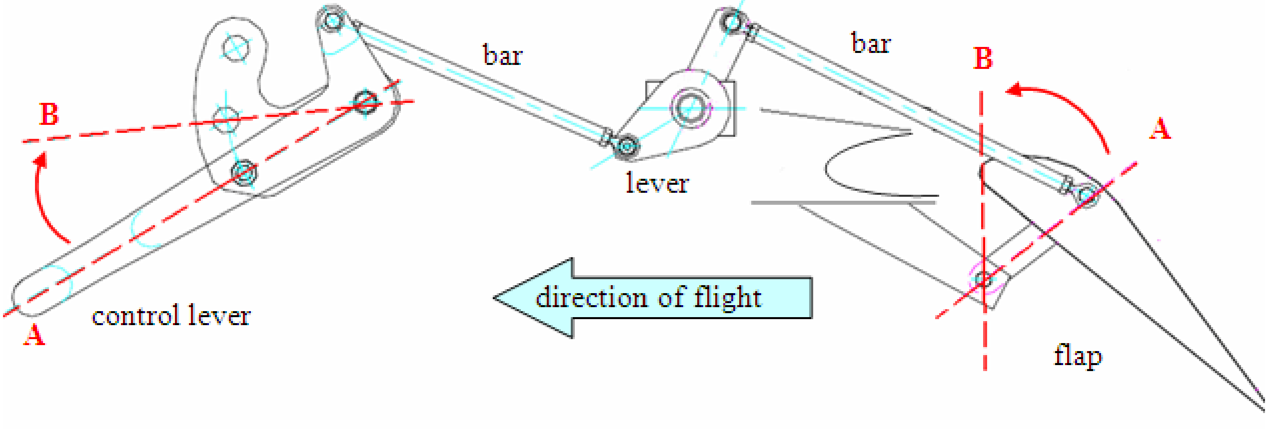

Fig. 2.1 The kinematic mechanism for operating the rigid flaps

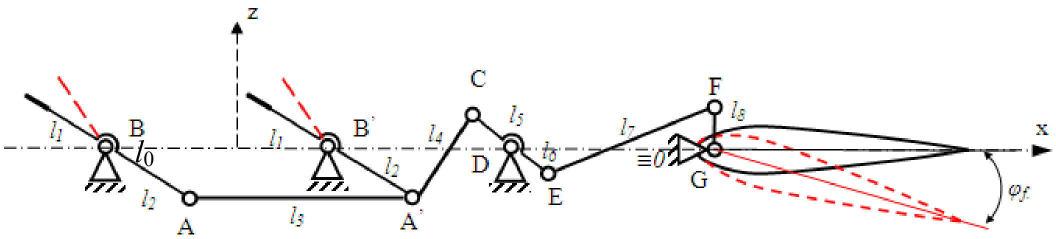

Fig. 2.2 Rigid kinematic mechanism for actuating the flaps (CAD solution)

2.2.Theoretical considerations.

The kinematic analysis of the articulated plan mechanism analyzed previously assumed structural analysis of kinematic couplings resulting connectivity, the number of independent contours, namely mobility mechanism. Based on kinematic scheme and the law of motion it is necessary to determine the intrinsic kinematic parameters mechanism (defining parameters) and the independent coordinates (input data).

The necessary reference system is adopted and the flap actuator relations between the unit vectors of the reference relatively to the base. In every contour considered a independent mechanism we each attach our own verse and fixed unit vector establish our own basic expressions for reference system. The stated problem for the analyzed case, is the vector equations which is written for each of the independent contours closing mechanism.

The equations reveal the unknown vector and closing through appropriate algebraic operations, we determined the necessary scalars and most importantly the law of motion transmission. We can determine successive derivations which require angular velocity and acceleration kinematics torso writing (reduced appropriately to chosen points). To control the flaps mechanism in the embodiment shown in Figure 2.2 it is necessary to determine the speed and acceleration functions.

We took into consideration the geometry mechanism in Figure 2.2 and Table 2.1 data analysis.

Tabel 1. Data analisys

Element antrenare $l_1 l_2$	500 mm
Element execuție l_9	500 mm
Timp de analiză	3s
Unghi levier φ_1	40^0
Unghi flaps φ_9	45^0

According to [7] we can define the kinematic mechanism function:

Conform [7] putem defini funcția cinematică ale mecanismului:

$$\varphi_{nj} = \varphi_{nj} \cdot (\varphi_{li}, l_k, \alpha_k) \quad (1)$$

Depending on the position of the mechanism it is analyzed as:

$$\varphi_f = \varphi_l(\varphi_i, l_1, l_2, l_3, l_4, l_5, l_6, l_7, l_8) \quad (2)$$

where φ – parameter position

2.3. The kinematics analysis of the control mechanism of the flaps.

For the kinematic analysis, we used a software tool called Artas SAM 6.1. This is an interactive software environment for the design, analysis, synthesis and optimization of planar mechanisms. SAM integrates a numeric preprocessor and post-processing analysis of animation and graphic display of parameters. The mathematical model is based on finite elements with a large number of characteristics allowing a unified approach for a number of highly complex mechanisms (ex. planetary gears). SAM 6.1 has a number of tools such as: design and modeling mechanisms, CAD interface, optimization mechanisms, post-processing and analysis of results [6].

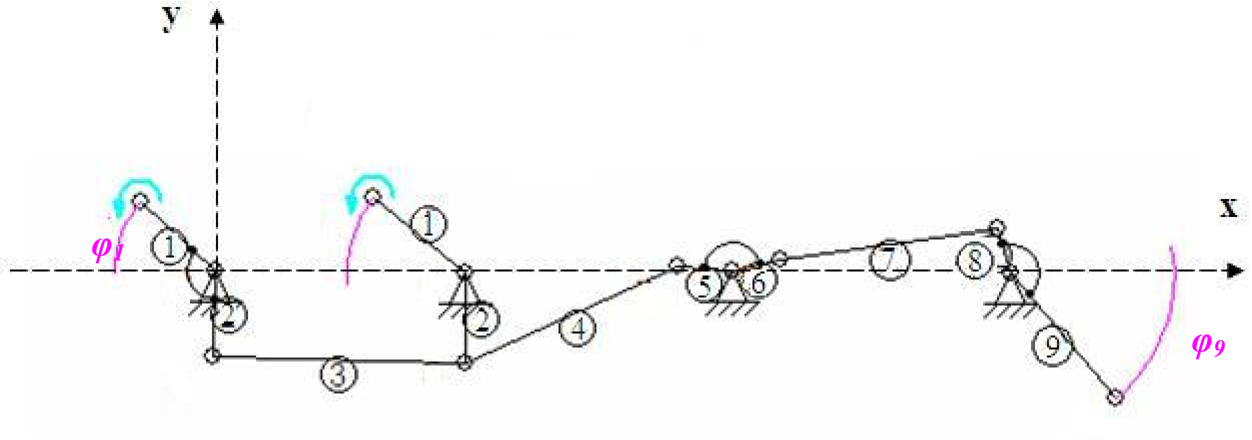

Fig. 2.3 The kinematic representation of a optimized rigid flap actuator SAM 6.1

Element 1/2 – control levers

Element 3, 4 şi 7 – link connections

Element 5/6 şi 8 – sticks

Element 9 – flaps

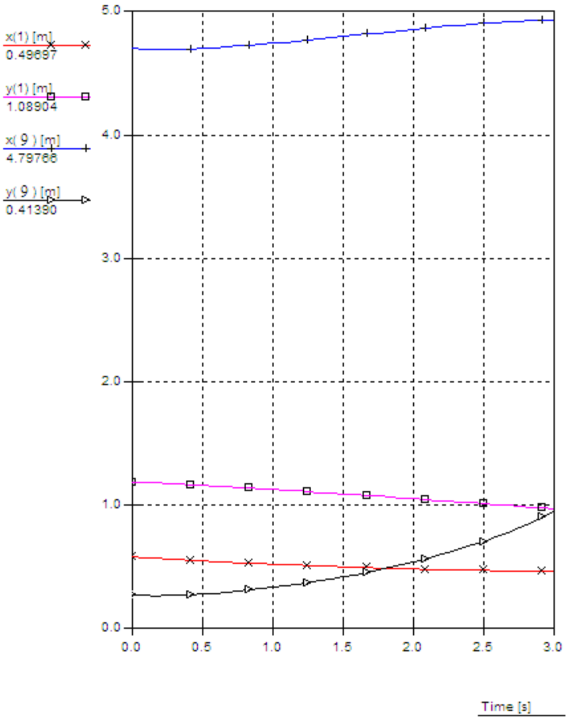

Fig. 2.4 Kinematic characteristics

We analyze the kinematic mobility (l_1,l_2) and a kinematic running element (l_9) separately and have the characteristics shown in Figure 2.4 and 2.5, values in Table 2

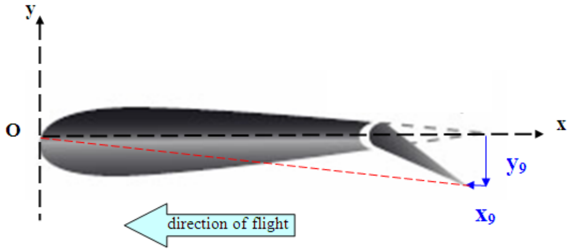

Fig. 2.5 Flaps coordonates

Tabel 2.1. Kinematic characteristics

Time [s]	x(1) [m]	y(1) [m]	x(9) [m]	y(9) [m]
0	0.576	1.187	3.7	0.272
0.5	0.545	1.157	3.703	0.276
1	0.519	1.124	3.744	0.33
1.5	0.497	1.088	3.799	0.416
2	0.479	1.05	3.857	0.536
2.5	0.467	1.009	3.907	0.703
3	0.461	0.967	3.926	0.949

3. CONCLUSIONS & ACKNOWLEDGMENT

3.1.Conclusions

The kinematic analysis of the mechanism can build a driveline of dimensional design commands for a simple type of damper flap.

3.2. Acknowledgment

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