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Analysis of Aircraft Wings Actuation Mechanism Control System

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ABSTRACT

This study deals with the aircraft wings movement using hydraulic actuator model. The simulation of wings model is designed with two cylinders, used to control both the aircraft wings. For this purpose we have used PID controller. The present paper describes the methodology of aircraft wings movement during landing and takeoff. In this , The computational techniques required for the wings simulation are analyzed and discussed. The actuation of wings is accomplished using two double acting hydraulic cylinders, one each for left and right wings. We have tested hydraulic circuit for different settings of PID controller; optimum value of PID controller is calculated. This work is based upon the simulation using automation studio software.

Keywords: Aircraft, Wings, Controller, Automation

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I. INTRODUCTION

In this paper we have simulated the aircraft wings movement during landing and takeoff. Ever since man started to think about flying, has striven to imitate the shape and structure of a bird wing. The requirement of many modern aircraft missions is of high value for aerodynamic efficiency. Fig.1 shows wing model structure. A aircraft wings model is established, and then flight control model is linearized by small disturbance. The wing structure model referred in this work is based on high-aspect-ratio near-space aircraft. Rotary wing aircraft is one of the most common aircraft configuration currently used after fixed wing.

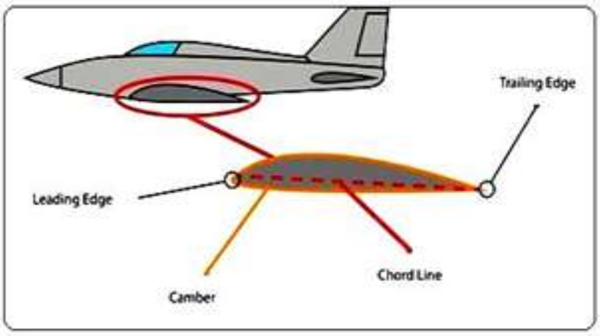

Fig.1 Wings Model

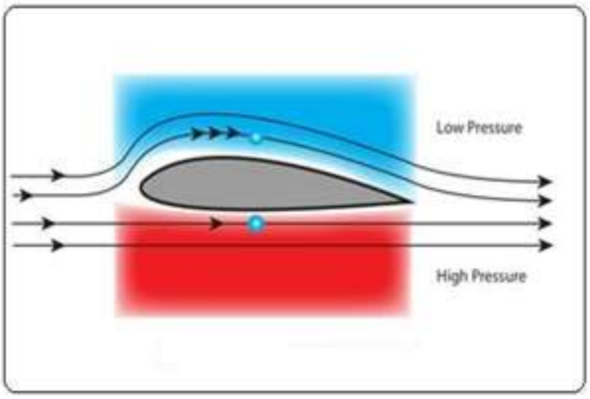

Fig.2 Wing Pressure Areas

Wing pressure areas is shown in Fig.2. The rotary wing is different as compared to fixed wing because of the way it generates aerodynamic forces, that is by rotating the rotor blades.

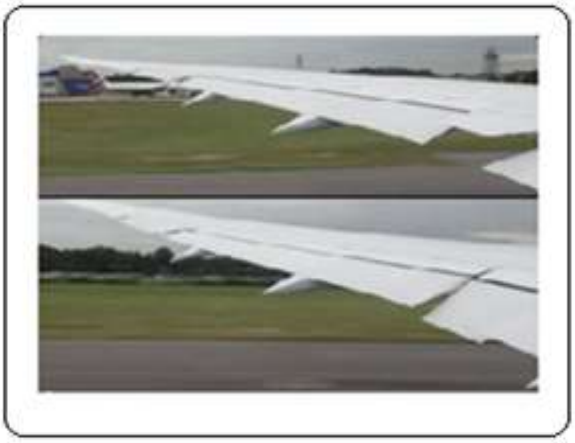

Fig.2(a) Aircraft Wing Movement

The wings of a fixed wing aircraft are static planes extending either side of the aircraft. In Fig.2(a) aircraft wings movement is shown. When the aircraft travels forward, airflow over the wings which are shape to create lift. Aircraft wings may have various devices, such as flaps or slats that the pilot uses to modify the shape and surface area of the wing to change its operating characteristics. That's the way we are using in two parallel cylinders and proportional control valve. This proportional valve is used to control the cylinders. This cylinders movement are forward and backward because of proportional control valve can control the cylinder.By using the PID controller and proper tuning, wing movement can be controlled precisely.

II. Methodology

In this study PID controller with its fine tuning is used, for the analysis of aircraft wings movement. The simulation is extremely demanding in terms of physical model involved. In this paper the computational techniques required for the aircraft wings simulation are discussed. Two actuator inputs are used for PID controller was implemented for altitude, stability of wing. The hydraulic circuit for controlling actuator movement is shown in Fig.3 and Fig.4. Before the actuation of cylinder, the wing movement is off. This is shown in Fig.3. The two cylinders are simulated together like the aircraft wings. The actuator piston rod connected to aircraft wings. The PID controller is used to control the two cylinders simultaneously at the same time. Fig.4 shows the circuit diagram after actuation, in which the cylinder moves from left to right side. In these models we have connected PID controller to the cylinder. Then after that we have set particular value of PID controller, so that two cylinders can move properly in forward and backward directions.

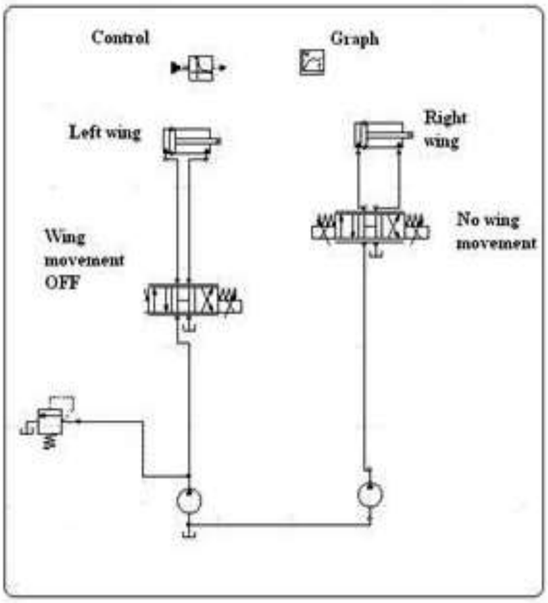

Fig.3 Before Actuation Of Cylinders

The graph set the PID values after that run the model. That time graph is locate the movement of cylinder in y(t) axis. We observed the proper movement of two cylinders. The complete cylinder actuation mechanism control system is shown in Fig.3 and Fig.4 respectively.

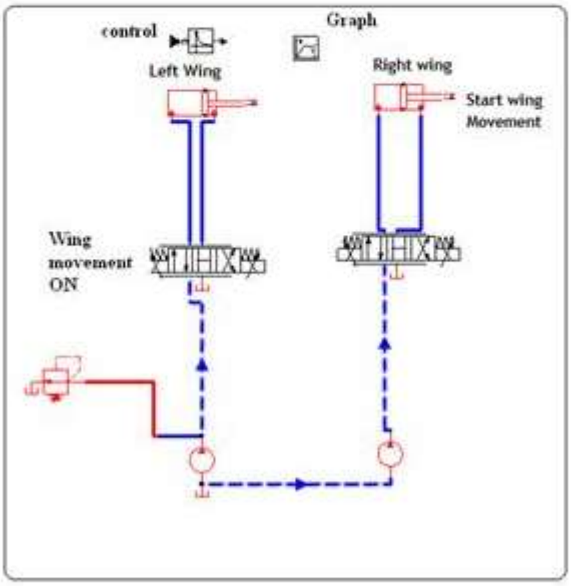

Fig.4 After Actuation Of Cylinder

III. Result Analysis

We observed the movement of two cylinders and this movement we have shown in below figures.

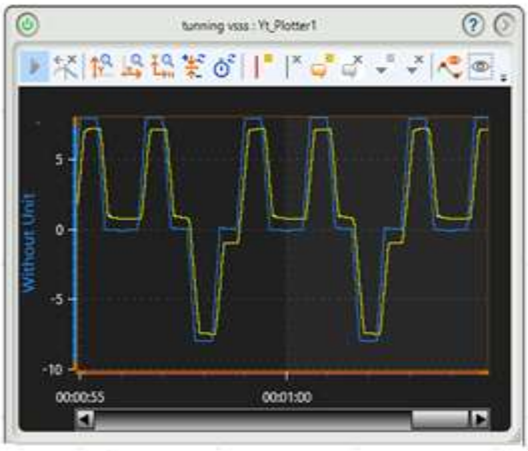

Fig.5 Wing Movement With PID Settings (Kp-0.2,Ki-0,Kd-0)

We have set different values for the PID controller. In fig .5, we have used Y (t) plotter from the response, the movement is not as per the required value. The PID values are Kp=0.2,K_i=0,K_d=0.

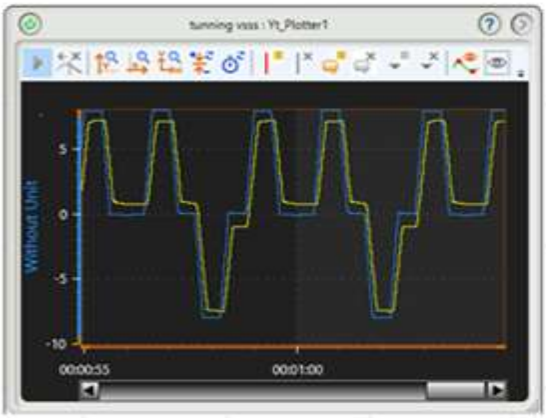

Fig.6 Using Movement Of PID (Kp-2.3,Ki-1,Kd-0.1)

Fig .6, shows the response of the actuator with the PID values, Kp=2.3ki=1,kd=0.1.

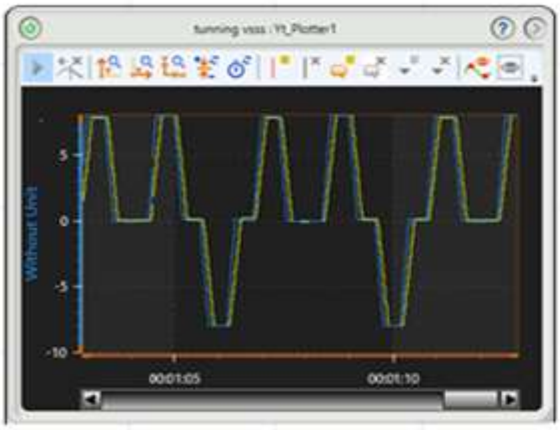

Fig.7 Wing Movement With PID Settings (Kp-3.75,Ki-2.3,Kd-0.2)

Fig.7 shows the response of control circuit for the PID values of kp=3.75,ki=2.3, kd=0.2.

From the response obtained, the movement is shows as per the required value. The values of kp, ki and kd is selected in such a way that the output variable matches the input variable thus stabilizing the movement of the wing in real time.

IV. Conclusion

In this work we have successfully analyzed and implemented the aircraft wings movement during takeoff and landing. The simulation is extremely demanding in terms of physical models. The PID controller activates the cylinder movement in forward and backward direction. With reference to the Fig.7 the optimum settings of the PID controller, controls the wings movement as per desired path.

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