World Academy of Science, Engineering and Technology
International Journal of Mechanical and Mechatronics Engineering
Vol:10, No:06, 2016

Application of the Piloting Law Based on Adaptive Differentiators via Second Order Sliding Mode for a Fixed Wing Aircraft

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Abstract : In this paper, we present a piloting law based on the adaptive differentiators via high order sliding mode controller, by using an aircraft in virtual simulated environment. To deal with the design of an autopilot controller, we propose a framework based on Software in the Loop (SIL) methodology and we use Microsoft^{TM} Flight Simulator (FS-2004) as the environment for plane simulation. The aircraft dynamic model is nonlinear, Multi-Input Multi-Output (MIMO) and tightly coupled. The nonlinearity resides in the dynamic equations and also in the aerodynamic coefficients' variability. In our case, two (02) aircrafts are used in the flight tests, the Zlin-142 and MQ-1 Predator. For both aircrafts and in a very low altitude flight, we send the piloting control inputs to the aircraft which has stalled due to a command disconnection. Then, we present the aircraft’s dynamic behavior analysis while reestablishing the command transmission. Finally, a comparative study between the two aircraft’s dynamic behaviors is presented.

Keywords : adaptive differentiators, second order sliding modes, dynamic adaptation of the gains, microsoft flight simulator, Zlin-142, MQ-1 predator
Conference Title : ICCAR 2016 : International Conference on Control, Automation and Robotics
Conference Location : Copenhagen, Denmark
Conference Dates : June 27-28, 2016