Hybrid Lateral-Directional Robust Flight Control with Propulsive Systems

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Abstract : Fixed-wing flying vehicles are usually controlled by means of control surfaces such as elevators, ailerons, and rudders. The failure of these systems may lead to severe or even fatal crashes. These failures resulted in increased popularity for research activities on propulsion control in the last decades. The present work deals with a hybrid control architecture in which the propulsion-controlled vehicle maintains its traditional control surfaces, addressing the issue of robust lateral-directional dynamics control. The challenges stem from the parameter uncertainties in the stability and control derivatives and some unknown terms in the flight dynamics model. Two approaches are implemented and tested: linear quadratic regulation with robustness characteristics and $H\infty$ control. The problem is centered on roll-yaw controller design with full state-feedback, which is able to deal with a standalone propulsion control mode as well as a hybrid mode combining both propulsion control and conventional control surface concepts while maintaining the original flight maneuverability characteristics. The results for both controllers emphasized very good control performances; however, the $H\infty$ controller showed higher stabilization rates and robustness albeit with a slightly higher control magnitude than using the linear quadratic regulator.

Keywords : robust propulsion control, h-infinity control, lateral-directional flight dynamics, parameter uncertainties
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