Adaptive Control of the Aircraft Pitch Angular Motion by using the Dynamic Inversion Principle

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Abstract— This paper approaches the adaptive control of an aircraft longitudinal motion by using the dynamic inversion principle, the parametric estimation, and the linear dynamic compensation. The control law has two components: the former is provided by a linear dynamic compensator, with the state tracking error as input; the latter is an adaptive component which represents the change rate of the estimated state vector deviation with respect to the desired one and the change rate of the variance between the system estimated output and the desired one, respectively. The obtained adaptive control structures consist of parametric estimators, dynamic compensators and command filters. The estimated state and the estimated output are calculated with respect to the estimated vector of the aircraft parameters. The obtained control system is particularized for the adaptive control of the pitch angular rate and the pitch angle, respectively, in the case of an F-15 aircraft whose flight may be affected or not by wind shears. The theoretical results are validated by numerical simulations in the absence or in the presence of wind shears by using complex Matlab/Simulink models; the states and the command variables history for the designed optimal control systems are plotted and the functionality of the two systems is proved.