

Nonlinear and fault-tolerant flight control using multivariate splines

This paper presents a study on fault tolerant flight control of a high performance aircraft using multivariate splines. The controller is implemented by making use of spline model based adaptive nonlinear dynamic inversion (NDI). This method, indicated as SANDI, combines NDI control with nonlinear control allocation based on an onboard aerodynamic spline model and a real-time identification routine. The controller is tested for an aileron hard over failure and structural damages which change the global aerodynamic properties of the aircraft. It is shown that the controller can quickly tune itself in failure conditions without the need of failure detection and monitoring algorithms. Instead, self-tuning innovation based forgetting is applied to reconfigure the onboard aerodynamic model. The controller is able to tune itself each time a model error is detected and does not require any external triggers for re-identification. Multivariate splines have a high local approximation power and are able to accurately model nonlinear aerodynamics over the entire flight envelope of an aircraft. As a result the identification routine gives a robust adaption of the aerodynamic model in case of a failure.