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FAULT ACCOMMODATION FOR NEAR SPACE HYPERSONIC VEHICLE WITH ACTUATOR FAULT

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Abstract. *Based on fuzzy control and sliding mode observer technique, a fault accommodation strategy is proposed for near space hypersonic vehicle (NSHV) with actuator fault in this study. Firstly, the Takagi-Sugeno (T-S) fuzzy model is implemented to represent the NSHV nonlinear dynamics, and a bank of sliding mode observers are designed for the established T-S model, which are used to generate the residuals. Then, a novel fault diagnostic algorithm is given to estimate the actuator fault occurred in NSHV dynamics. Utilizing the on-line obtained fault estimation information, a fault accommodation scheme is developed to compensate for the effects of actuator fault. Based on Lyapunov stability theory, a sufficient condition to guarantee the stability of faulty system is derived in terms of linear matrix inequalities (LMIs), which can be easily solved by Matlab LMI toolbox. Finally, simulation results are presented to demonstrate the efficiency of the proposed approach.*

Keywords: Fault accommodation, Near space hypersonic vehicle, Sliding mode observer, T-S fuzzy model

1. **Introduction.** Near space hypersonic vehicle (NSHV) is one of the new aerospace vehicles, which offers a promising and cost-effective technology for access to space, and provides global strike capabilities. However, NSHV is sensitive to changes of physical and aerodynamic parameters due to environment and flight conditions which are usually coupled with altitude and Mach numbers. Therefore, faults may occur in any location and dramatically change the system's capability resulting in degradation or even instability. To achieve higher survivability even when fault occurs, the fault diagnosis and accommodation for NSHV has turned into one of the greatest aeronautical research challenges.

One of the difficulties to deal with NSHV is that the dynamics are complex nonlinear, multi-variable and strongly coupled [1,2]. In this study, T-S fuzzy technique [3-5], which is a well known effective technique for modeling and controlling nonlinear systems, is considered. The main reason is that T-S fuzzy model can be used to describe nonlinear systems effectively by approximating any smooth nonlinear functions to any specified accuracy within any compact set, and the control design can be carried out on the basis of the fuzzy model. The advantage of T-S fuzzy modeling is that a large class of nonlinear plants can be well replaced by local linear models by choosing appropriate fuzzy rules and