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THE MODELING AND TERMINAL SLIDING MODE FINE ATTITUDE CONTROL FOR AEROELASTIC HYPERSONIC VEHICLE

Abstract

For cost efficient and time reduced flights in both commercial and military areas, air-breathing engine powered hypersonic vehicle with its significant dual-use value, becomes the main research direction of current near space flight technology. As the aeronautics and space technology's integrated product, hypersonic vehicle features complex flight environment, wide range of flight envelop, variable dynamic characteristics, stringent control requirements and so on, all of which propose many new research challenges to flight control system design. To ensure a good scramjet inlet environmenta hypersonic vehicle should be controlled as a fine attitude control. But the elastic vibration greatly influences the accuracy of attitude control. Taking the longitudinal channel of hypersonic vehicle for example, the impact of elastic problem on the flight control system is analyzed and a elastic aerodynamic model is established in this paper. Considering the large-scale perturbation of model parameters caused by body engine coupling and aerodynamic heating, the fine attitude control system is designed base on terminal sliding mode theory under a active control strategy. Simulation results show that, under the condition of measurement noise, nonlinear actuator and large-scale perturbation of model parameters, the rigid body angle of attack is tracked exactly and the flexible angle of attack is well suppressed. The control accuracy of local angle of attack of inlet is with in + 0.4 degrees, and can meet the requirements for fine attitude control.