Paper ID: 30643
poster
student

SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)
Interactive Presentations (IP)

Author: Dr. Jie Liang
China

Dr. xiao hanshan
China Aerodynamics Research and Development Center(CARDC), China

# FAST TERMINAL SLIDING MODE ATTITUDE CONTROL FOR HYPERSONIC FLIGHT VEHICLE WITH DISTURBANCE OBSERVER

**Abstract**

Hypersonic vehicle generally refers to the flight which speed is more than Mach 5, flying in the atmosphere and across the atmosphere. Hypersonic vehicle has a broad applied prospects, it could help to achieve economic and efficient development of space. The dynamic characteristics of the hypersonic aircrafts will vary considerably over the flight envelop than other aircrafts due to their extremely wide range of operating conditions and rapid change of mass distributions. Furthermore, because of airframe-integrated scramjet utilized and the flight conditions of high altitudes and mach numbers, hypersonic aircrafts are very sensitive to changes in atmospheric conditions. Moreover, many aerodynamic and propulsion characteristics still remain uncertain and are hard to predict due to the effect of the structural dynamics, propulsion aerodynamics and coupling between them. As a result, the hypersonic vehicle model is uncertain, multivariable, unstable, and possesses significant input-output cross-coupling. Therefore, it is essential to design flight controllers with high non-linear control ability and robustness for hypersonic aircrafts. The thesis was based on the though to control configured to conduct some research on the flight control system whose core was the reentry attitude control techniques, completed the design and simulation of control strategies and law for the whole reentry process, and established a solid foundation for further research on the attitude control techniques of hypersonic aircraft. In this paper, the three-freedom-degree model and six-freedom-degree model considering the effects of earth rotation were built to meet the demand of hypersonic aircraft on the control system design and the validation of simulation, fast terminal sliding mode controller is designed based on the compensation of nonlinear extended state observer. To estimate disturbance angle speed and system by using observer, then compensation using a fast terminal sliding mode controller, improve the robustness of the control system, to realize the stable tracking guidance command. The proposed control algorithm does not depend on the system model, the angular velocity signal and control weight coefficient matrix without measurement and feedback system of the inverse calculation. In addition, the proposed continuous smooth sliding mode reaching law can be in a finite time convergence to the sliding surface, effectively eliminate the chattering, has strong robustness to system parameter perturbation. Finally, simulation results show that the proposed control scheme for six degree of freedom model is effective for reentry.