Electrical & Computer Engineering

S E M I N A R

Louisiana State University

X-33 Reusable Launch Vehicle Flight Control System Design

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Abstract—The flight control of NASA's X-33 Reusable Launch Vehicle (RLV) poses a challenge to conventional gain-scheduled flight controllers due to its large attitude maneuvers from liftoff to orbit and reentry. In addition, a wide range of uncertainties in vehicle handling qualities and disturbances must be accommodated by the attitude control system. Nonlinear tracking and decoupling control by trajectory linearization can be viewed as the ideal gain-scheduling controller designed at every point on the flight trajectory. Therefore it provides robust stability and performance at all stages of flight without interpolation of controller gains, and eliminates costly controller redesigns due to minor airframe alteration or mission reconfiguration. A prototype X-33 ascent flight controller was designed using the trajectory linearization method and tested with 3-DOF and 6-DOF simulations at the NASA Marshall Space Flight Center. It is noted that the 6-DOF results were obtained from the 3-DOF design with only a few hours of tuning, which demonstrates the inherent robustness of the design technique. It is this "plug-and-play" feature that is much needed by NASA for the development, test and routine operations of RLVs. Plans for further research will also be presented.

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