In this paper, we present a global adaptive output feedback control scheme for a class of uncertain nonlinear systems to which adaptive observer backstepping method may not be applicable directly. The allowed output feedback structure includes quadratic and multiplicative dependency of unmeasured states. Our novel design technique employs a change of coordinates and adaptive backstepping. With these proposed tools, we can remove linear and quadratic dependence on the unmeasured states in the state equation. Also, the multiplication of the two unmeasured states can be eliminated.

A gain-scheduled autopilot design for a bank-to-turn (BTT) missile is developed by using the Linear Matrix Inequality (LMI) optimization technique and a state-space linear interpolation method. The missile dynamics are brought to a quasilinear parameter varying (quasi-LPV) form. Robust linear control design method is used to obtain state feedback controllers for the LPV systems with exogenous disturbances at the frozen values of the scheduling parameters. Two gain-scheduled controllers for the pitch axis and the yaw-roll axis are constructed by linearly interpolating the robust state-feedback gains. The designed controller is applied to a nonlinear six-degree-of-freedom (6-DOF) simulations.

The resulting stabilizing controller in this paper consists of the disturbance estimator and the gain scheduled controller. The disturbance estimator tracks the unknown external disturbance and its derivative information in the closed-loop control system using fuzzy logic based adaptation law. Moreover, the gains of the stabilizing controller are appropriately scheduled according to the estimated values. Furthermore, since the estimation law is combined with the stabilizing controller in the closed control loop, it asymptotically minimizes the estimation error. In order to confirm the usefulness of the proposed control scheme, it is applied to the magnetic suspension systems.