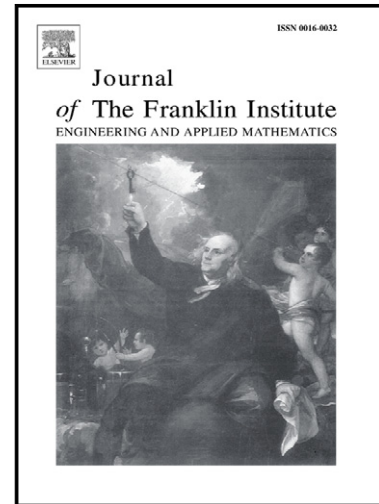


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Roll control using discrete-time robust sliding hyperplanes and fast output sampling

Prasad Parkhi¹, Bijnan Bandyopdhyay², Mahendra Jha¹

Abstract

Robustness to unmatched parametric uncertainty is prime requirement of roll control algorithm, especially when it is discretized and implemented through on-board processor. Sliding mode control is a well established non-linear control technique, which ensures a robust performance in presence of matched uncertainties and disturbances. In case of the discrete version of sliding mode control, due to finite operational sampling frequency, the system trajectories can not be forced to slide on the switching manifold. The trajectories remain confined to certain domain around the sliding surface and this is known as Quasi Sliding Mode (QSM) motion. The bound of QSM decides the accuracy and performance of the discrete version of sliding mode. By design, the discrete-time sliding modes are robust to the matched bounded perturbations, however, unmatched perturbations directly affect the boundary layer width and hence the performance of the system. In the present paper, discrete time Lyapunov inequality based sliding hyperplane is designed, which enables robustness to unmatched perturbations arising due to uncertain system matrix A . Further, the requirement of full state-vector for the design of control and sliding surface is met through the multi-rate output feedback (MROF). This control strategy is then demonstrated with application to roll position control of missile with a bandwidth limited actuator.

Keywords:

Roll autopilot, discrete-time sliding modes, discrete-time Lyapunov inequality, Linear matrix inequality, Parametric unmatched uncertainties.

Email addresses: prasadp@sc.iitb.ac.in (Prasad Parkhi),
bijnan@sc.iitb.ac.in (Bijnan Bandyopdhyay), mjha@arde.drdo.in (Mahendra Jha)

¹Scientist, PGM-TECH Department, ARDE, Pune-411021, INDIA.

²IDP in SYSCON, Indian Institute of Technology Bombay, Mumbai-400076, INDIA.

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