Name: Bhargavi Chaudhary

Entry No.: 2020EEZ8419

Thesis Title: On the Design of Positive Observer and Event-Triggered Controller for Positive Systems

Abstract

Positive linear systems are essential for modeling physical, biological, and industrial processes where state variables must inherently remain non-negative. However, their strict structural constraints often render classical unconstrained control techniques ineffective. To accommodate these unique properties, this thesis develops a unified, positivity-preserving framework for the estimation and stabilization of continuous-time positive linear systems subject to communication and physical constraints. Specifically, the research introduces novel algebraic observers designed for strictly diagonally dominant and large-scale networked systems to guarantee accurate, non-negative state estimation. Beyond reliable estimation, practical networked systems also require highly efficient resource management. To address bandwidth limitations, the study designs dynamic event-triggered, self-triggered, and asynchronous output-feedback strategies that significantly reduce data transmission while ensuring asymptotic stability, closed-loop positivity, and the strict exclusion of Zeno behavior. Additionally, the work tackles physical actuator saturation through an LMI-based anti-windup compensation scheme that maximizes the admissible domain of initial conditions without compromising state positivity. The proposed methodologies are validated numerically and also verified through real-time experiments on multi-tank systems, providing scalable, resource-aware, and physically consistent control design for constrained dynamical networks.