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Regional stability and stabilization of a class of linear hyperbolic systems with nonlinear quadratic dynamic boundary conditions

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Abstract

This paper addresses the boundary control problem of fluid transport in a Poiseuille flow taking the actuator dynamics into account. More precisely, sufficient stability conditions are derived to guarantee the exponential stability of a linear hyperbolic differential equation system subject to nonlinear quadratic dynamic boundary conditions by means of Lyapunov based techniques. Then, convex optimization problems in terms of linear matrix inequality constraints are derived to either estimate the closed-loop stability region or synthesize a robust control law ensuring the local closed-loop stability while estimating an admissible set of initial states. The proposed results are then applied to application-oriented examples to illustrate local stability and stabilization tools.

Keywords: dynamic boundary conditions, Poiseuille flow, linear hyperbolic systems, robust control, LMIs.

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