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H^∞-Optimal Boundary Control of Hyperbolic Systems with Sampled Measurements[1]

Ming Qing Xiao

Department of Mathematics
Southern Illinois University, Carbondale, IL 62901

Abstract. This paper studies the finite-horizon H^∞-optimal control problem for linear hyperbolic systems when only time-sampled values of the state are available, with control acting on the boundary. The problem is formulated in a differential game framework by associating a zero-sum differential game with the original disturbance attenuation problem. The minimizing player's minimax strategy in this game corresponds to the optimal controller in the disturbance attenuation problem, which is linear and is characterized in terms of the solution of a particular generalized Riccati evolution equation. The optimum achievable performance is determined by the condition of existence of a solution to another family of generalized Riccati evolution equations. The formulation allows for the control to be time-varying between two consecutive sampling times, and in this respect the paper presents optimum choices for these waveforms as functions of sampled values of the state.
Keywords. H^∞-optimal boundary control, hyperbolic systems, differential games,Riccati equation.
AMS (MOS) subject classification: 49, 47, 45.

1 Introduction

Boundary control of systems governed by partial differential equations is one of the most important problems in control theory, and there are still many problems in the boundary control of linear distributed parameter systems that need to be addressed. Early papers treating boundary control problems are due to Balakrishnan [4] and Washburn [22], who developed further an old idea of Fattorini [10]. Simplifications and refinements through domains with fractional powers were introduced by Triggiani [18]. Keulen [14], McMillian and Triggiani [16], and Barbu [5] were among the first to study H^∞ boundary control problems involving particular types of partial differential equations.However, all these works required the optimal control to be *continuous* state/output feedback. In practice, output information is not always available as a continuous stream. In fact, output information is often only available at *discrete* time instants. Hence a feedback scheme which only uses sampled data is an attractive choice from a practical viewpoint. For the H^∞-control problem with sampled state measurements in *finite* dimensions,

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