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DESIGN OF AN OPTIMAL PREVIEW SERVOMECHANISM FOR DISCRETE-TIME SYSTEMS IN A MULTIRATE SETTING

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Abstract. This paper presents an LQ optimal preview servomechanism design method for linear discrete-time systems with time-delay in the multirate control setting. By making use of the discrete-time lifting technique, we reduce the multirate preview control problem to the single-rate one for a certain augmented system. Applying the standard LQ optimal preview control method to this augmented system, we characterize the optimal multirate preview controller in terms of a certain algebraic Riccati equation. The resulting optimal controller is a time-varying controller with periodic feedback gain matrices. It is show that the above Riccati equation has a positive semi-definite stabilizing solution under the standard assumptions for the optimal servomechanism design of the original system. A numerical example is included to illustrate the applicability of the present results.
Keywords. preview control, multirate control, discrete-time lifting technique, algebraic Riccati equation, servomechanism.
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1 Introduction

The preview control is a technique of improving the transient response of the closed-loop system by utilizing the finite future information of reference signals and/or exogenous disturbances. Since the original work by Tomizuka [20], numerous advances have been made in the theory of preview control problems. The linear quadratic (LQ) optimal control problem with preview compensation has been extensively studied for the last three decades [20, 21, 1, 13, 12, 14, 22, 8, 15]. Moreover, in order to guarantee the robustness against exogenous disturbances and model uncertainties, the H_∞ criterion has been introduced into the preview control [4, 5, 6, 7, 18, 23]. Most of these works are successful in both continuous-time and *single-rate* discrete-time systems.