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A State Space Solution to the Robust Stabilization Problem of Discrete-Time Multirate and Periodic Systems

Kan Tan[1], Li Chai[2] and Li Qiu[2]

[1]Department of Mechnical Engineering
University of Houston, Houston, TX 77204 USA
[2]Department of Electrical and Electronic Engineering
Hong Kong University of Science and Technology
Clear Water Bay, Kowloon, Hong Kong, China

Abstract. In this paper we present a state space solution to the robust stabilization problem of general discrete-time multirate and periodic systems where the uncertainty is described in terms of the gap and $\nu-$gap metric. This robust stability problem is converted to a constrained $\mathcal{H}_\infty$ optimal control problem by using the lifting technique. Then the optimal robust stability margin is explicitly computed and a method is provided to get the controllers satisfying the optimal robust stabilization margin. The solution amounts to solving two discrete-time algebraic Riccati equations and an extended Parrot problem.
Keywords. multirate systems, periodic systems, robust stabilization, graphs of operators, $\nu-$gap metric

1 Introduction

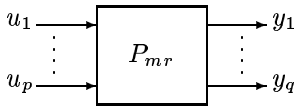

Figure 1: A general multirate system.

A general multivariable discrete-time multirate system is depicted in Figure 1. Here the signals $u_1, \ldots, u_p$ and $y_1, \ldots, y_q$ are discrete-time signals with different sampling rates. Such a multirate system can result from sampling an analog system using multirate samplers and holds or can appear as it is in some special applications. In our study, we assume that this system is linear and causal, and satisfies certain periodic property. Because of this, it can be converted to an equivalent LTI system using the so-called lifting or blocking technique [9, 13, 15]. Hence the analysis and design techniques for