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MULTIRATE RELIABLE REGULATION OF UNCERTAIN SYSTEMS FORCED BY BOUNDED EXOGENOUS SIGNALS

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Abstract. This paper considers the design of digital control systems, where the measurement mechanism is nonstandard, that is, each output is measured at its own rate.

It begins with the *Regulator Problem (RP)*, which calls for asymptotic stability and zero error regulation in the case where the exogenous signals are nonvanishing, bounded and with a rational spectrum, that is, are generated by a system with simple eigenvalues on the boundary of the unit disk.

Then, a couple of other problems dealing with robustness issues are faced in the same framework.

First the case where some loops open because of failures in the instrumentation (sensors and actuators) is addressed, leading to the *Reliable Regulator Problem (RRP)*, which requires that stability and zero error regulation are maintained, to the maximum possible extent, even in these situations.

Then, the design of a single regulator for a whole set of systems, representing various possible models of a partially uncertain plant, is considered in a second problem, called *Simultaneous Regulator Problem (SRP)*.

Constructive conditions for both centralized and decentralized control structures are given. They allow to solve the above problems by means of time invariant, least order regulators, under the assumption that the plant is asymptotically stable.

Keywords. Multirate control systems, stabilization, regulation, robustness, centralized and decentralized control.

1 Introduction

Multirate control systems are characterized by the fact that each input is updated at its own rate and/or each output is measured at its own rate; as such, they are able to model many real-life situations. These control systems have received a great deal of attention for many years, the relevant research activity having followed two different directions [1]. Many authors assume that the updating/measurement scheme is to be designed, whereas other authors face classical design problems for a fixed nonstandard updating/measurement scheme. This paper follows the second stream of activity and first tackles the *Regulator Problem (RP)* (asymptotic stability, even in the presence of plant parameter variations, and zero error regulation) in the case where the exogenous signals are generated by a system with simple eigenvalues on the boundary of the unit disk, so that they are nonvanishing, bounded and with