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JOINT DESIGN OF RESET CONTROLLER AND COMMUNICATION SCHEME

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Abstract. *This paper investigates the problem of designing communication sequences and a communication scheme that can stabilize a reset control system where the sensors and actuators of the plant communicate information with a remote controller through a shared communication network with limited bandwidth. The design procedures of the communication sequences governing the medium access at the sensor-controller side and the controller-actuator side are shown to be separable and a useful design algorithm is derived in the sense of reachability and stabilizability. The communication schemes of both sides are designed by transforming the feedback stabilization problem into an equivalent problem of generalized communication with feedback. We also show that the achievable transmission rate (Shannon rate) of the communication scheme is given by the Bode's sensitivity integral formula characterizing the degree of instability of the reset control unit.*

Keywords: Networked reset control systems, Communication sequence, Reachability, Stability, Transmission rate

1. **Introduction.** The main idea of a reset controller is to allow its states or some of them to be reset to zero when the input to it is zero. There are two basic advantages of a reset controller: the ability of overcoming dangerous overshoots that cannot be satisfactorily rejected by linear compensators; and more flexibility in controller design [1]. The study of reset control systems began with the introduction of the so-called Clegg integrator [5], for which a detailed mathematic model was given in [8]. Motivated by this, a systematic controller design procedure based on the Clegg integrator was presented in [12]. In [3], necessary and sufficient conditions on internal stability were obtained for a second order plant. However, this stability result is not easily testable and usable. A more easily understandable and implementable result can be found in [2], where Lyapunov-based conditions for asymptotic stability and computable conditions for quadratic stability based on linear matrix inequalities (LMIs) were proposed for general reset systems. As a generalization of the existing stability results, a Lyapunov-based stability result was presented in [7] for general reset systems.

The study of networked control systems (NCSs) has been receiving increasing attention in the past decade, see, e.g., [6] and [15]. Some interesting topics and recent research progresses in the area of NCSs can be seen in the survey papers [14] and [11], and the references wherein. Strictly speaking, any communication networks have finite communication channels or bandwidth so that only a limited number of sensors and actuators can be accommodated at any time. In such a situation, one is faced with a challenging task involving the joint design of a policy for managing controller-plant communication and a feedback controller that guarantees performance and stability requirements for the