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STOCHASTIC STABILIZATION OF SAMPLED-DATA NETWORKED CONTROL SYSTEMS

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Abstract. *This paper mainly investigated a sampled-data control approach to deal with the stabilization problem of Networked Control Systems (NCSs) with packet losses and bounded time varying delays. A new Lyapunov-Krasovskii functional candidate is constructed to analyze the stability of the overall system with bounded random packet losses and time varying delays. As a result, corresponding stabilizing sampled-data controller is designed based on the stability conditions. A real-time network measurement system has been developed based on MATLAB applications. Instrument Control toolbox was used to implement communications between two computers with MATLAB applications via the Internet. Experiments were done to demonstrate the real network properties. A real-time networked control system has been constructed to test the stabilizing ability of the controller design in a real network environment. Experimental results illustrate the effectiveness of the proposed approach, a good combination of the theory and the real applications.*

Keywords: Sampled-data control, Networked control systems, Packet loss, Time varying delays, Linear matrix inequality (LMI), Lyapunov method

1. **Introduction.** NCSs are feedback control systems with control loops closed via digital communication channels. Advantages of NCSs include low cost, high reliability, less wiring, easy system set-up and maintenance [1]. However, the insertion of communication network in the feedback control loop complicates the application of standard results in the stability analysis and control design because many ideal assumptions made in the classical control theory can not be applied to NCSs directly. The study of NCSs raises new interesting and challenging problems such as time delays, packet losses and communication bandwidth [2].

One of the most important issues in NCSs is the problem of losing data which occurs because of limited bandwidth and large amount of data packet transmitted over one line. For the real industrial applications, a good design of the feedback controller using the most fresh information to stabilize the NCS is very essential. Another common issue is the network-induced delay effect on the control loop. For real applications, delays and packet loss could become the potential sources of instability and poor performance of NCSs due to the critical real-time requirements in control systems.

Recently in the study of NCSs, the impact of packet loss and time delay has been paid increased attention such as shown in the literature: [3-23].

In [3], the issue of data packet loss is modelled as a Markovian process, but it dealt with the delay which is less than one sampling time interval. In [1], the maximum packet-loss rate under which the overall system remains stable was investigated. In [8], the NCS has been formulated as a Markovian jump system with known packet loss rate, the