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STATE FEEDBACK CONTROLLER DESIGN OF NETWORKED CONTROL SYSTEMS WITH TIME DELAY IN THE PLANT

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Abstract. *This paper is concerned with the network control problem for linear time delay systems. We employ a Networked Control Systems (NCSs) model, taking into consideration both the network-induced delay and the time delay in the plant. On the basis of the given model, a controller design method is proposed by using the delay-dependent approach. An appropriate Lyapunov functional candidate is utilized to lead to new criteria by combining the free-weighting matrix method. The feedback gain of a memoryless controller can be derived by solving a set of Linear Matrix Inequalities (LMIs). Moreover, the correlation between the network-induced delay and the time delay in the plant is investigated. A numerical example is given to illustrate the effectiveness of our method and the reciprocal influences between the network-induced delay and the delay in the plant.*
Keywords: Networked control system (NCS), Linear matrix inequality (LMI), Lyapunov functional candidate, Network-induced delay, Stability

1. **Introduction.** The study of stability analysis and control design of NCSs has been attracting considerable attention because of many advantages with NCSs. The network-induced delay (sensor-to-controller delay and controller-to-actuator delay as well as the computation delay in controller) occurs while exchanging data among devices connected to the shared medium. The delay which can be constant, time-varying, or even random is frequently a source of instability and performance deterioration of control systems [1-4].

The research for the time-delay systems [5-9] made a solid foundation for analyzing the time-delay effect in the framework of NCSs. However, since all devices in an NCS are distributed on one common-bus network and sensors use a sampling mechanism, the system inputs are piecewise constant with delays. Due to the sharing of network communication, the packet loss is also inevitable in the transmission [10]. These properties have not been discussed in previous time-delay analyzes, which present some challenges for modeling and analyzing of NCSs. A lot of efforts have been made to solve the problems of stability and stabilization of NCSs.

The stability problem of the NCSs has received extensive consideration in recent years. In [2], the stability analysis was presented based on stability region method, under the assumption that the network-induced delay is constant and less than a sampling period. A