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ROBUST CONTROLLER DESIGN FOR ATM NETWORK WITH TIME-VARYING MULTIPLE TIME-DELAYS

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Abstract. *For the congestion of the Asynchronous Transfer Mode (ATM) networks with time-varying multiple time-delays and changeful available bit-rate (ABR) bandwidth, an ABR flow controller is designed and the LMI-based delay-dependent stabilizability criteria is proposed. The algorithm, which is independent of the derivative of varying delays, is less conservative and can be implemented easily. It also achieves two expectant goals, i.e. it satisfies a weighted fairness condition and ensures convergence of queue length to the desired steady-state value. Simulation results show that the control system is robust and rapid and the quality of service (QoS) is guaranteed.*
Keywords: Congestion control, Time-varying time-delays, LMI

1. **Introduction.** Congestion in computer networks is the main reason for reduced performance and poor QoS. Therefore, congestion control of computer networks received a growing attention in control community recently, ATM in particular which is a key technology for integrating broadband integrated services (B-ISDN) in heterogeneous networks where data, video and voice sources transmit information. To support multimedia traffic, the ATM Forum [1] has defined five service classes of which ABR is the ideal one that responds to network congestion by means of a feedback control mechanism in order to improve network utilization. The ATM forum decided to use a closed-loop rate-based congestion control scheme as the standard for the ABR service, which may be classified into two schemes: 1) Binary feedback scheme. 2) Explicit rate (ER) scheme.

Our focus in this paper is on the explicit rate feedback framework. Over the years, many congestion control algorithms have been proposed on control theoretic principles in this framework. In [2], a congestion controller is proposed for the networks with multiple delays. This algorithm, however, requires a complex online tuning of control parameters to ensure stability and to damp oscillations under different network conditions. In [3], based on the work in [2], the authors design a dual PD controller, where the control parameters can be designed to ensure the stability of the control loop in a control-theoretic sense, over a wide range of traffic patterns and propagation delays. In [4], a control scheme based on a smith predictor with a proportional controller inside is presented. Although it can lower the average queue level, the scheme is sensitive to the round-trip delays between the source and the switches on the connection path. So if the propagation delays change,