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ROBUST H_∞ FAULT-TOLERANT CONTROL FOR UNCERTAIN NETWORKED CONTROL SYSTEM WITH TWO ADDITIVE RANDOM DELAYS

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Abstract. *The paper is concerned with the problem of robust H_∞ fault-tolerant control for uncertain networked control system with random delays and actuator faults. The sensor-to-controller delay and controller-to-actuator delay are modeled as two continuous-time discrete states Markov chains. Based on a practical and general model of actuator faults, the faulty networked control system is modeled as a Markovian jump system with two additive random delays. By using the Lyapunov-Krasovskii functional method, the sufficient conditions on stochastic stability and H_∞ performance for the faulty networked control system are given. The corresponding controllers design methods are proposed in terms of linear matrix inequalities. Furthermore, the proposed approach is extended to uncertain networked control system with actuator faults. Finally, an illustrative example is provided to demonstrate the effectiveness of the proposed results.*

Keywords: Fault-tolerant control, Networked control system, Random delays, Actuator faults, H_∞ control

1. **Introduction.** With the increasing requirements on reliability and safety of engineering systems, the fault-tolerant control problem has been the focus of much research literatures in the last decades, see e.g. [1-7] and the references therein. The existing results mainly focus on the traditional control systems in which the point-to-point communication architecture is adopted. In recent years, the rapid growth of communication networks has led to the emergence of networked control system (NCS), where the feedback control loops are closed through shared communication network. However, the insertion of communication networks introduces some new problems, such as time delays, packet dropouts [17]. These problems make the FTC analysis and designs for NCS more complex. Furthermore, the conventional fault-tolerant control theory with many ideal assumptions must be re-evaluated when it is applied to NCS. Therefore, the study of fault-tolerant control for NCS has theoretical and practical significance [8].

In NCS, network-induced delay is one of the most important issues. In recent years, it has been a hot research topic [10-13,17]. Network-induced delay has been modeled in various probabilistic ways [9,14]. The most attracting way is to model the delay as Markov chain. For the discrete-time domain case, in [9], sensor-to-controller delay and sensor-to-controller delay were modeled as Markov chains. The necessary and sufficient condition on the stochastic stability of NCS was given. For the continuous-time case, the NCS