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ROBUST OBSERVER BASED RELIABLE CONTROL FOR SATELLITE ATTITUDE CONTROL SYSTEMS WITH SENSOR FAULTS

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Abstract. *The problem of both robustness to parameter uncertainty and fault-tolerant to sensor faults for satellite attitude control system is discussed in this paper. More general and practical continuous type of sensor fault is considered here. Both prior known sensor faults and unknown sensor faults are investigated for satellite attitude control systems. Reliable controller based on a modified observer is realized by means of LMI, which guarantees the stability of the closed-loop system and reduces the conservatives of the system design. Numerical simulation demonstrates the effectiveness of the proposed method.*

Keywords: Satellite attitude dynamics, Robust, Fault-tolerant control, Sensor faults, LMI

1. **Introduction.** A control system designed to tolerate faults of sensor or actuator, while maintaining an acceptable level of the lost loop system stability and performance is called a reliable control system [1]. On the design of this kind of reliable control system, the component faults have been taken into account at the controller design stage. Once a controller is designed, it remains fixed. For safety-critical systems, such as satellites or space vehicles, safety and reliability are more important than their good performance. One of the methodologies which can improve system reliability is robustness against component faults.

In practical system, analysis of a mathematical model is usually important for a system. However, the mathematical model always contains some uncertain elements. As for satellites, these uncertainties may be due to additive unknown internal or external noise, environmental influence, nonlinearities [2,3]. So linear model of the satellite attitude control system cannot well represent the system for further study. In recent years, much research work has been done on uncertain systems [4-12,17-19]. In [4,5,17], a reliable control scheme for linear time-varying delay systems against sensor faults via an observer-based method is given. However, the sensor fault parameter must be precisely known primarily because the sensor fault parameter is not only introduced in the given LMI conditions but also in the constructed faulty observer.

This paper is aimed at fault-tolerant control for satellite attitude system responding to sensor fault. Different from [5], a linear model with uncertainties of system parameters is considered in this paper. Similar as in [11], the input disturbance is also taken into account for fault-tolerant controller. Referred to [7], a more general and practical continuous fault model is considered for sensor faults. Unlike [12], a modified observer referred to [13] is constructed. Then based on it, a reliable controller is designed. Both known sensor