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ADAPTIVE OBSERVER BASED FAULT DIAGNOSIS FOR SATELLITE ATTITUDE CONTROL SYSTEMS

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Abstract. *This paper presents a novel fault diagnosis method for satellite attitude control systems. Under Lipschitz condition on the nonlinear part of such systems, a nonlinear adaptive observer is for the actuator fault diagnosis. Moreover, the convergence and its speed of the developed algorithm are also investigated. Finally, simulation results have been included to demonstrate the feasibility and effectiveness of the new designed techniques.*
Keywords: Fault diagnosis, Adaptive observer, Satellite attitude control system

1. **Introduction.** Attitude control is an important part of satellite control systems, which is used to keep the satellite stable or in a stationary motion, so it is necessary to consider the reliability of attitude control system. However, because of the increasing complexity of the satellite, it inevitably raises the probability of faults occur. The consequence of the faults is very serious for the satellite from the viewpoint of the economical cost and risk. Thus, there is a growing need for the onboard fault diagnosis for satellite attitude control systems to enhance its reliability.

In recent years, some effective techniques of the fault detection and diagnosis for satellite attitude control systems have been developed, such as neural networks [1,2], neural adaptive observer [3,4], expert system [5-7] and support vector machine (SVM) based method [8]. Note that the neural network based fault diagnosis methods always need online weights adjustment, which is time costing due to complex computation especially for the back propagation (BP) network, therefore, they are not quite applicable for the online fast fault identification. On the other hand, because of the complexity of the satellite systems, many faults cannot be known prior, so the expert system often cannot obtain satisfactory results for many faults occurred in satellite attitude control systems. Also, SVM online training needs some parameters available, however, for systems with unknown faults, it is often difficult to choose appropriate parameters.

In this paper, we extend our previous work in [9,10] to a class of nonlinear control systems and apply it to the satellite attitude control systems. Under the Lipschitz condition on nonlinear part, first, we design the observer gain matrix, then, an adaptive algorithm with modification is developed, and the adaptive algorithm can identify the actuator fault in a quick and effective way.