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ATTITUDE AND BIAS ESTIMATION OF THE AGILE SATELLITE WITH HIGH DYNAMIC PERFORMANCE BASED ON L1-TSAKF

Abstract

With the increase in space activities and the expansion of mission requirements, agile satellites need to switch satellite control modes rapidly and gaze a rapidly moving target with the temporary observation mission to achieve space situational awareness. This poses higher demands for the dynamic performance of agile satellites. The current research on high-dynamic flying vehicles is mainly focused on aircraft with large overloads in near space, such as ballistic missiles and hypersonic aircraft. As for agile satellites, less research has been conducted on high dynamic performance. The high dynamic performance of the agile satellite manifests in both large-angle maneuvering and rapid tracking at the high angular velocity. The high dynamic performance of agile satellites brings new challenges in attitude estimation. Due to the large angle maneuvering consuming fuel, the moment of inertia of the agile satellite exhibits time-varying characteristics. In addition, rapid tracking of targets often involves large angular accelerations, leading to non-Gaussian characteristics. This paper studies the attitude estimation problem of the agile satellite with high dynamic performance. Firstly, the specific definition and representation of the high-dynamic performance of the agile satellite is given in this paper. Secondly, considering the time-varying moment of inertia, non-Gaussian noise, and unknown bias effects during rapid maneuvering of the agile satellite, the attitude dynamics and control system model is established. Thirdly, combined with a real-time moment of inertia identification, the L1 norm two-stage adjusted Kalman filtering algorithm (L1-TSAKF) is proposed to simultaneously estimate the state and bias during the attitude maneuvering process. The numerical simulation results show that the L1-TSAKF algorithm can achieve high precision attitude estimation in the rapid maneuvering process, which is conducive to the application of agile satellites in orbit.