World Academy of Science, Engineering and Technology
International Journal of Computer and Systems Engineering
Vol:16, No:08, 2022

Robust Attitude Control for Agile Satellites with Vibration Compensation

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Abstract : We address the problem of robust attitude tracking for agile satellites under unknown bounded torque disturbances using a double-gimbal variable-speed control-moment gyro (DGVSCMG) driven by a cluster of three permanent magnet synchronous motors (PMSMs). Uniform practical asymptotic stability is achieved at the torque control level first. The desired speed of gimbals and the acceleration of the spin wheel to produce the required torque are then calculated by a velocity-based steering law and tracked at the PMSM speed-control level by designing a speed-tracking controller with compensation for the vibration caused by eccentricity and imbalance due to mechanical imperfection in the DGVSCMG. Uniform practical asymptotic stability of the overall system is ensured by loan relying on the analysis of the resulting cascaded system. Numerical simulations are included to show the performance improvement of the proposed controller.

Keywords : agile satellites, vibration compensation, internal model, stability
Conference Title : ICCA 2022 : International Conference on Control Applications
Conference Location : Kuala Lumpur, Malaysia
Conference Dates : August 30-31, 2022