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ATTITUDE ESTIMATION AND CONTROL DESIGN FOR SINGLE STEERABLE SINGLE WING SATELLITE

Abstract

Steerable single solar wing satellite can offer more visible space for payload, maintain solar array Sun pointing without attitude maneuverer and makes itself an ideal platform for many Earth observation missions. The coming FORMOSAT-7/COSMIC-II mission dedicated to atmosphere temperature measurement using GPS radio occultation technique employs such a satellite design to provide nadir pointing attitude all over the 72-degree orbit where Sun beta angle will vary between 90. One FORMOSAT-7 satellite developed by NSPO as a technology demonstration and validation platform under the umbrella of FORMOSAT-7 mission also adapt the same design since it will share the same ride with the rest of the FORMOSAT-7 spacecraft. Given the benefit of steerable single solar wing design, the attitude estimation and control will be challenge because of its time varying dynamics. Note that, from time to time, the steerable single solar wing will rotate faster than orbit rate to reacquire Sun. In such a scenario, the disturbance torque exerted from solar panel might compromise its well-controlled attitude and increase mission down time. In this paper, two satellite dynamics with steerable single solar wing will be introduced: One for attitude estimation design while the other will be the simulation model. The simple model for attitude estimation and control design purpose is derived from the concept of angular momentum conservation. The other one is derived from generalized force which will be able to capture more subtle details of steerable single solar wing satellite dynamics. Both models come with a simple yet ideal solar array drive model to reproduce commanded solar array track and trim motion and 1st mode

out-of-plane flexibility. The proposed gyroless attitude estimation scheme and 3-axis control design are validated on 6DoFs simulation where promising performance is observed.