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SMC BASED HEADING CONTROL OF A SATELLITE MODEL WITH DUO COLD THRUSTERS

Abstract

This paper proposes an attitude control of a satellite using a sliding mode control algorithm and its performance evaluation using a satellite testbed. The testbed of the satellite system is designed and built to mimic the attitude control while the satellite is orbiting on a 2D platform. The satellite testbed consists of a flat table, a satellite model, and a counterbalance mass. The satellite model consists of a lower part and an upper part which can be rotated independently. The lower part of the satellite model is attached with flat air bearings and linked to the counterbalance mass to mimic the gravitational force for balancing the satellite model during orbiting on the flat table. The lower part of the satellite is equipped with an IMU to measure the angle of the orbit. The upper part of the satellite is equipped with another IMU. Based on the relative angles between the two IMUs, the actual satellite's heading is determined. Two cold gas thrusters at the left and the right sides are used to control the heading of the satellite. Total dynamics of the satellite model depends upon two subsystems dynamics; the cold gas thruster dynamics and the satellite's attitude dynamics. The sliding mode controller (SMC) which is a nonlinear and robust control algorithm is proposed to control the duty cycles of the two on-off cold gas thrusters. The control performance is evaluated from both simulation and experimental results. In the first evaluation, the proposed SMC is used to control the satellite's heading from an arbitrary initial angle to zero degree, then after 10 seconds the heading is controlled to +10 degree and then -10 degree after another 10 seconds. In the second evaluation, the satellite's heading is controlled from an arbitrary initial angle to zero degree, then after 10 seconds the heading angle is controlled to +30 degree. Based on the results from both simulation and experiment, the controller can achieve the satellite heading efficiently.