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ROBUST ATTITUDE CONTROL USING ELECTROSPRAY THRUSTER

Abstract

Electric thrusters have become a popular option for small satellite propulsion because of their propellant efficiency, reliability, and versatility. Propellant is accelerated using various electrical and/or magnetic physical principles. Because the propellant is ejected at velocities significantly higher than a conventional chemical thruster, electric propulsion is much more fuel efficient, ultimately requiring smaller amounts of propellant. Several electric thruster technologies exist, covering a large range of missions and requirements. Among these, electrospray thrusters, which generate thrust by accelerating particles from an ionic liquid, present unmatched performance at low power. Electrospray is a promising solution both for orbital control as primary propulsion, but also for spacecraft attitude control, acting as an actuator. This paper presents the study of attitude control of a spacecraft using an electrospray thruster-based attitude actuator. Robust controllers are explored, and specifically, different Super Twisting Sliding mode control laws algorithms have been tested. The controller performs attitude tracking during various mission phases and spacecrafts size, considering a navigation sensors-derived uncertainty and on-board estimation. A study of the location and size of the actuators is performed as well, analyzing the impact on the performance of the controller in achieving and maintaining the desired attitude. The performance is evaluated in terms of power, propellant consumption and pointing error, showing how the robust controller can reject external disturbances and deal with modeluncertainties.