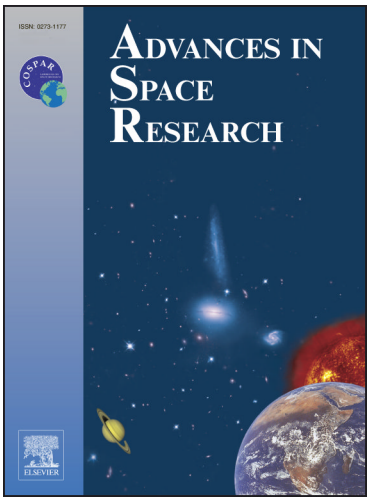

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Attitude Control for On-Orbit Servicing Spacecraft Using Hybrid Actuator

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On-orbit servicing is one of the research hotspots of space missions. A small satellite equipped with multiple robotic manipulators is expected to carry out device replacement task for target large spacecraft. Attitude hyperstable control of a small satellite platform under rotations of the manipulators is a challenging problem. A hybrid momentum exchanging actuator consists of Control Moment Gyro (CMG) and Reaction Wheel (RW) is proposed to tackle the above issue, due to its huge amount of momentum storage capacity of the CMG and high control accuracy of the RW, in which the CMG produces large command torque while the RW offers additional control degrees. The constructed dynamic model of the servicing satellite advises that it's feasible for attitude hyperstable control of the platform with arbitrary manipulators through compensating the disturbance generated by rapid rotation of the manipulators. Then, null motion between the CMG and RW is exploited to drive the system to the expected target with favorable performance, and to overcome the CMG inherent geometric singularity and RW saturation. Simulations with different initial situations, including CMG hyperbolic and elliptic singularities and RW saturation, are executed. Compared to the scenarios where the CMG or RW fails stabilizing the platform, large control torque, precise control effect and escape of singularity are guaranteed by the introduced hybrid actuator, CMGRW[i] .The feasible performance of the satellite, CMG and RW under large disturbance demonstrates that the control architecture proposed is capable of attitude control for on-orbit servicing satellite with multiple robotic manipulators.

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[i] CMGRW refers to the hybrid momentum exchanging devices in this paper, consisting of 4 CMGs in classical pyramid cluster and 3 RWs in an orthogonal group (specific description can been found in section 4).