Spin-axis stabilization of gyroless and underactuated rigid spacecraft using modified Rodrigues parameters

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Abstract: We consider a target pointing problem of a spacecraft which has fewer control torques than the degrees of freedom to be controlled. In addition, we consider the failures of rate measurement sensors. To overcome such failure situations, a novel method to represent control error, without applying any complicated attitude estimation algorithm, is proposed using geomagnetic field measurements. The proposed error representation does not require any toque on an axis which loses control. We derive a feedback control law using modified Rodrigues parameters that globally and asymptotically stabilizes the spacecraft about the underactuated spacecraft axis along the specified target direction in an inertial frame. Simulation was carried out and results are presented illustrating the effficacy of the proposed algorithm under the condition of measurement uncertainties and environmental disturbances.

Author Keywords: Actuator failure; Rate sensor failure; Spin-axis stabilization; Underactuated control

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