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DECENTRALISED ANTI-WINDUP FAULT TOLERANT CONTROL DESIGN FOR SATELLITE ATTITUDE STABILIZATION

Abstract

A decentralized anti-windup (AW) fault tolerant control (FTC) scheme is presented to address the problem of spacecraft model uncertainties, external disturbances, actuator faults and saturation. Modified Rodrigues parameters (MPRs) are used for attitude representation and expands the model of the spacecraft. The design of the decentralized FTC scheme involves the design of an individual AW compensator for each channel representing each principal axis of the spacecraft attitude. To achieve this, the nominal controller is also designed to ensure it satisfies the expanded model and allows the proposed design to be implemented and ensure asymptotic stability of the system. The design is inspired by ESTCube-2 nanosatellite model for attitude stabilization with reaction wheels momentum as control input to the FTC scheme with controller gain scheduling. Numerical simulations are reported with reaction wheels momentum limit set as $1.5 \times 10^{-3} Nms$ to show the effectiveness of the developed FTC scheme.