Evaluation of a spacecraft attitude and rate estimation algorithm

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Abstract: Purpose - This paper aims to present the development and performance evaluation of an attitude and rate estimation algorithm using an extended Kalman filter structure based on a body-referenced representation of the state. Design/methodology/approach - The algorithm requires only geomagnetic field data and can be used as a low-cost alternative or as a back-up estimator in the case of attitude sensor failures. The satellite rate is estimated as a part of the filter state and thus no gyroscope is necessary. The assessment of the algorithm performance is realized through a Monte Carlo simulation using a low-Earth orbit, nadir-pointing satellite. Findings - Given some attitude and rate error requirements, the range of admissible initial errors on the filter state and the effect of un-modelled disturbance torque are determined, along with the achievable attitude and rate accuracies. Practical implications - Because the simulation set-up is clearly stated, the results of this evaluation can be used as a benchmark for other estimation algorithms. Originality/value - The necessary assumptions and approximations used to derive the filter equations are explicitly pointed out for the benefit of the readers. Well-defined filter initial conditions are used in an extensive series of tests resulting into a unique set of findings. © Emerald Group Publishing Limited.
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