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Author: Mr. Elias Solorzano
Space Flight Laboratory, University of Toronto, Canada

Mr. Karan Sarda
Space Flight Laboratory, University of Toronto, Canada

A FIBER OPTIC GYRO-BASED ATTITUDE CONTROL SYSTEM FOR AUTONOMOUS TARGET TRACKING

Abstract

Autonomous terrestrial target-tracking applications using small satellites are demanding stringent pointing performance, prompting the need for developing high-precision attitude estimation and control systems that adhere to cost and mass constraints. Based on high-fidelity simulations and in-orbit results, it has been demonstrated that the standard attitude determination & control system onboard the Space Flight Laboratory's NEMO-class satellites is capable of constraining the attitude and rate estimation errors to below $0.05°$ and $0.04°/s$ during terrestrial target tracking maneuvers, and the overall pointing performance error can be constrained below $0.3°$ (2σ). While the attitude performance offered by the ADCS of the NEMO-platform enables a very wide range of important applications from low-Earth orbit, in anticipation to missions demanding more stringent pointing performance, a higher-precision ADCS technology is already under development at the Space Flight Laboratory of Toronto, Canada. This paper discusses the design of a robust ADCS architecture tailored to constrain the ground target pointing error of NEMO-class satellites to well below $0.1°$ (3σ). An attitude determination filter that combines single or dual star tracker measurements sampled at exactly 1Hz fused with three orthogonally-mounted high-grade miniaturized fiber optic gyroscopes (FOGs) operating at higher cadence (5Hz) is presented. To evaluate the performance of this system, autonomous ground-target tracking simulations using the mission and system parameters of a NEMO-platform in low-Earth orbit were conducted for inertially-fixed and moving-target scenarios.