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EXPERIMENTAL ANALYSIS OF A MINIATURE STABILIZATION STAGE FOR LASERCOM TERMINALS ONBOARD NANOSATELLITES

Abstract

The exploitation of small scale satellites - including pico and nanosats – for complex or high performance scenarios is still prevented by their severe technical limitations; in particular, the up/down radio link capabilities of such miniature spacecraft are bounded roughly to 1 Mbit/s. This is due to the limited onboard resources in terms of power and volume. Overcoming this issue will possibly make miniature satellites suitable for earth mapping, environment monitoring, ships and aircraft tracking, surveillance or even telecom networking scenarios, representing a competitive alternative to the existing LEO and GEO systems. In fact, the costs and production time of such small spacecraft are orders of magnitude lower than that of traditional systems. In general, the exploitation of miniature satellites with enhanced capabilities will dramatically reduce the cost and time of access to space for universities, research centres and small private companies, enabling easier on orbit science and technology demonstration, as well as profitable activities. A promising solution is represented by lasercom technology, which permits to achieve data rates up to one Gbit/s with very compact and light devices, if compared to radio frequency systems with comparable performance. However, the very stringent pointing accuracy required by optical links cannot be achieved by the typical attitude control of small satellites. For this reason, the authors are developing a miniature active stabilization stage, whose task is to serve as a vibration-free base to lasercom terminals onboard nanosatellites. The system consists of a three rotational degree-of-freedom parallel platform; active control is required to manage low-frequency vibrations, while high frequency disturbances are rejected by passive isolators. In this paper, a simplified prototype of the stabilized platform as well as its dynamical model are described. The results from experimental tests conducted to evaluate the system performance are presented; the experimental data are also compared to the results from numerical simulations for model validation.