Paper ID: 18955
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SPACE SYSTEMS SYMPOSIUM (D1)
Enabling Technologies for Space Systems (2)

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A MINIATURE STABILIZED PLATFORM FOR LASERCOM TERMINALS ON-BOARD NANOSATELLITES

Abstract

In the last decade miniature satellites have become attractive thanks to their inherent advantages: the reduced mass, production cost and time, as well as the low launch cost allow small companies, corporations and universities to access to space easily. Moreover, constellations based on miniature satellites for observation, mapping or telecommunication purposes could represent an alternative to systems based on larger platforms, thanks to the further cost reduction due to mass production. However, pico- and nano-satellites still present severe technical limitations which prevent their exploitation for complex or high-performance missions. In particular, the reduced available power and volume restrict up/downlink data rates to a few hundred kbit/s. To this day, optical links represent the unique viable solution to increase dramatically the communication capabilities of nanosatellites. In fact, only lasercom technology, thanks to the very narrow beam emission, permits to achieve data rates up to one Gbit/s with devices which can fit on a nanosatellite host bus in terms of volume, mass and power consumption. RF systems with comparable performance would inevitably exceed the resources available on such miniature platforms.

However, the extremely stringent pointing accuracy and stability required by optical link terminals are not compatible with the actual and perspective attitude control performance of nanosatellites. In order to overcome these technical limitations, the authors are developing a miniature actively stabilized platform capable of rejecting the residual bus vibration and provide a small optical link device a vibration-free base. Its exploitation will allow to relax the requirements on both the attitude control system of the host spacecraft and the coarse and fine pointing systems of the optical communication terminal, making the miniaturization of the latter easier. The device consists of a parallel, three rotational degrees of freedom platform controlled by means of three identical actuators based on piezoelectric elements. The active control is required to manage low-frequency vibrations, while high frequency disturbances are rejected by high-stiffness elastic elements. The parallel configuration is chosen for its simplicity, symmetry and overall stiffness.

In this paper, the design of the actively stabilized platform is presented, along with the numerical simulations performed in order to evaluate the system performance.