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Title

Miniature Fast Steering Mirrors (FSM) for Space Optical Communication in NanoSats and CubeSats

Authors

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Abstract

Since the democratization of computers and internet and the recent rise of connected objects, the Society has been more and more digitalized. Access to data has become vital and strategical for individuals and nations, Earth planet preservation and monitoring, and mobility applications. In this context, the number of satellite constellations projects is growing drastically worldwide and is a a next generation challenge of the NewSpace cost efficient industry.
So far, existing satellites constellations have been using radio frequencies (RF) for satellite-to-ground communications, inter-satellite communications, and feeder link communication. However, RF have several limitations such as limited bandwidth, low protection level. To address these limitations, space optical communication will be the new trend, addressing both very high speed and as secured encrypted communication
Fast Steering Mirrors (FSM) are a key components used in optical communication as well as space imagery, and for a large field of functions such as Point Ahead Mechanisms (PAM), Raster Scanning, Beam Steering Mirrors (BSM), Fine Pointing Mechanisms (FPM) and Line of Sight stabilization (LOS).
Staring from former space heritage CEDRAT TECHNOLOGIES (CTEC) has achieved the design and qualification of a piezo mini-FSM for 3U CubeSats, targeting an undisclosed constellation composed of several hundreds of satellites. This mini-FSM offers a stroke of +/-6 mrad and a resonant frequency of 1700 Hz, with a mass of 50 gr.
This FSM mechanism is a good candidate for giant constellations and all applications on board NanoSats and CubeSats, featuring very high level of miniaturization, and optimized for NewSpace high quantities cost efficiency, The use of piezo actuators offers a high resonance frequency for optimal control, with almost zero power consumption in step and stay pointing, and with very high reliability figures > 0,995 demonstrated over years of recurrent manufacturing for Optronic applications at CTEC.
The following paper, presents the design of the mini-FSM and associated CCBµ20 drive electronics, , as well as test results including pointing performances, closed loop position control, long duration vibrations test over hours. and other environmental tests performed on the system.

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