

Miniature Fast Steering Mirrors for Space Optical Communication on NanoSats and CubeSats

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Abstract : With the increasing digitalization of society, access to data has become vital and strategic for individuals and nations. In this context, the number of satellite constellation projects is growing drastically worldwide and is a next-generation challenge of the New Space industry. So far, existing satellite constellations have been using radio frequencies (RF) for satellite-to-ground communications, inter-satellite communications, and feeder link communication. However, RF has several limitations, such as limited bandwidth and low protection level. To address these limitations, space optical communication will be the new trend, addressing both very high-speed and secured encrypted communication. Fast Steering Mirrors (FSM) are 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). The main challenges of space FSM development for optical communication are to propose both a technology and a supply chain relevant for high quantities New Space approach, which requires secured connectivity for high-speed internet, Earth planet observation and monitoring, and mobility applications. CTEC proposes a mini-FSM technology offering 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 a very high level of miniaturization and optimized for New Space 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 Optronics applications at CTEC.

Keywords : fast steering mirror, feeder link, line of sight stabilization, optical communication, pointing ahead mechanism, raster scan

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