Advanced Fast Steering Mirror for Ultra-precise Stabilized Optical Systems
Technology #12083

Applications

An advanced fast steering mirror (FSM) has applications in interferometry, airborne and space-borne acquisition and tracking systems, and long-range optical communication and data transfer.

Problem Addressed

The primary function of an FSM is to actively isolate the optical system of interest from vibrations and other disturbances. This is accomplished by placing a small mirror (or other optical payload) under closed-loop control in one or two rotational axes (pitch and/or yaw). In prior FSM embodiments, such as the High Bandwidth Steering Mirror (HBSM) variants, the mirror payload and supporting structure were suspended via metallic flexures and driven in two degrees of freedom via Lorentz force (voice-coil) actuation. This and similar designs have flown successfully and have demonstrated good performance in bandwidths approaching 10 kHz. This technology is a new high-performance FSM design with a closed-looped bandwidth of 20 kHz, and peak angular accelerations of $5 \times 10^5$ rad/sec$^2$.

Technology

This design has two key technologies that improve its performance over other FSMs. First, the Lorentz force actuators of previous designs will be replaced with a new flux-steering-type hybrid actuator. This actuator is characterized by its very high force density and accompanying small payload mass, which enable payload accelerations of 500 g or greater. Second, the metallic flexure bearings used in prior designs will at least partially be replaced with preloaded elastomeric bearings. These bearings exhibit very high stiffness in compression, but relatively low stiffness in shear. In addition, elastomeric materials are inherently well-damped, which will eliminate spurious flexure nodes known to be problematic in prior designs. The lack of such nodes in combination with careful engineering of the payload structure, will allow the target performance goals to be realized.

Advantages

- Increased closed-loop bandwidth
- Increased peak angular acceleration

Categories For This Invention:

Mechanics
Photonics
Intellectual Property:
Variable reluctance fast positioning system and methods
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FIG. 1