

Application Note: Adaptive Optics



Cryogenic Actuators

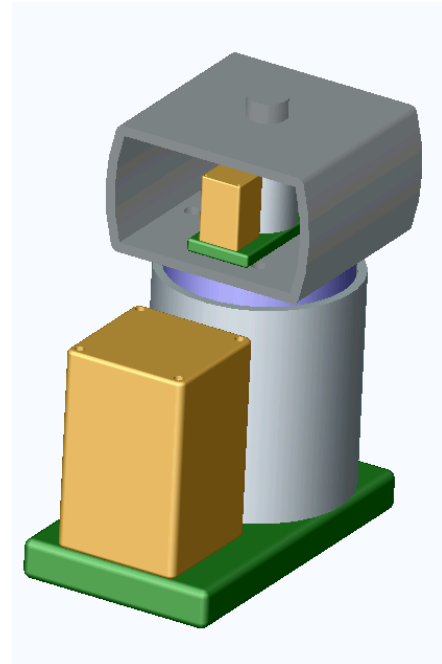
Energen, Inc. has built and demonstrated cryogenic actuators and linear stepper motors applicable to the needs of the James Webb Space Telescope (JWST) being developed by NASA. These actuators are based on cryogenic magnetostrictor materials that deliver greater motion than any other “smart” material system. Energen has demonstrated prototypes of all four of the actuator identified as critical technology for JWST - shape, position, force, and deformable mirror. Shape actuators provide for short stroke precision shaping of the primary mirror; Position actuators provide tip, tilt and piston motion of mirror segments, force actuators provide direct force control and small compact array of actuators are used in secondary mirrors for adaptive wavefront control.

Tip-tilt-piston Actuators

Large, ground-based telescopes being developed at many observatories around the world, are being designed with segmented primary mirror following the success of the Keck Observatory in Hawaii. A key requirement of segmented mirrors is that the wavefront from all the segments must be phased correctly or the image will be distorted.

To achieve a high degree of coherence between segments, actuators are needed to precisely position each mirror segment to nanometer accuracy. The Keck telescope uses hydraulic actuators, which require frequent maintenance resulting in considerable downtime for observations.

Energen is developing nanometer-class actuators that can deliver the tip-tilt-piston motion needed for ground-based telescopes. These actuators provide nanometer resolution over 10s of millimeters range. Their low-power design eliminates thermal expansion effects and they hold position when powered off, even under a 250 kg load.



Energen's expertise in magnetic “smart” materials (MSM) has enabled innovative positioning, vibration control, and shape control solutions. MSM-based solutions span a size scale of six orders of magnitude, from microvalves enabling microfluidic and sensing applications to elevator brakes and jet blast deflectors with tens of thousands of pounds of force capability. Energen actuators and linear motors are being applied successfully to diverse applications such as precision positioning of telescope optics, active vibration and jitter control of weapons platforms, and tuning of particle accelerator cavities.

Energen's current development thrust aims to exploit the commercial potential of magnetic smart materials in thin film form. Thin film MSM actuators have the potential to enable more robust drug delivery systems, disposable chemical and biological sensors, lightweight large-scale optics, and many other applications not yet envisioned.

Energen's success in delivering high value-added solutions to its customers derives from its collaborative business model. The Company partners with academic institutions, national laboratories, government agencies, and industry to pursue application-specific opportunities in its customer's market niche. Through these partnerships, our customers leverage their resources by accessing a broader range of technology than that in which they invest directly.

Since its founding in 1996, Energen has developed a proven track record of successful cross-disciplinary collaboration, having delivered state-of-the-art solutions to commercial customers and the Federal Government, funded in part through 15 SBIR awards. Energen has assembled a team of recognized experts and has a reputation for quality.