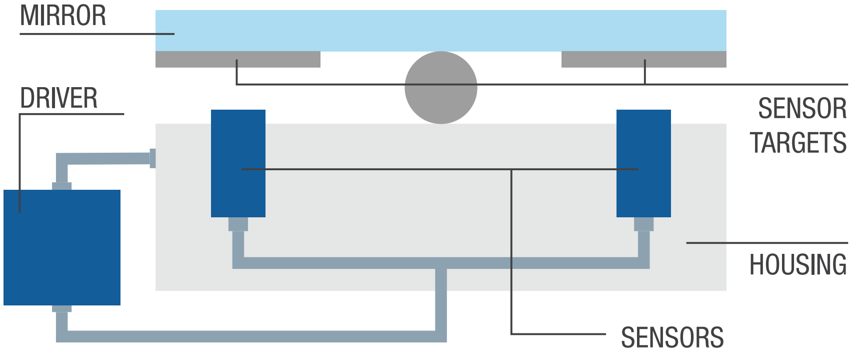
How Do Fast Steering Mirrors (FSM) Work?

Fast Steering Mirrors, or FSM for short, are physical systems composed of a reflective mirror, a pair of motion-tracking sensors, a displacement actuator, and a processing unit that aid in receiving an incoming signal beam at the correct angle or redirecting it in a specific direction. The mirror is mounted on top of a rotating structure with four sensor targets on the back and a sensor below each. The design allows for tilting in two axes (X & Y) according to the processing unit's instructions.

Figure 1 – FSM Structure



Component Interaction

The FSM system's objective is to place the mirror in the correct position in both X & Y. The mirror starts with an initial position denoted by X0 and Y0. If the signal beam is being directed correctly, the mirror doesn't need to be moved. Once the beam changes direction, the mirror must tilt a specific angle in either the X or Y axis (or both). To define this exact tilt, the sensors below the mirror continuously measure the distance between the sensor head and the target. The positioning information is then shared and processed by the central driver, which delivers instructions to the displacement actuator to move the mirror (ΔX or ΔY) towards a specific direction on each axis. The process continues until the correct placement is reached for both axes, denoted by X1 and Y1.

Figure 2 – Initial Position

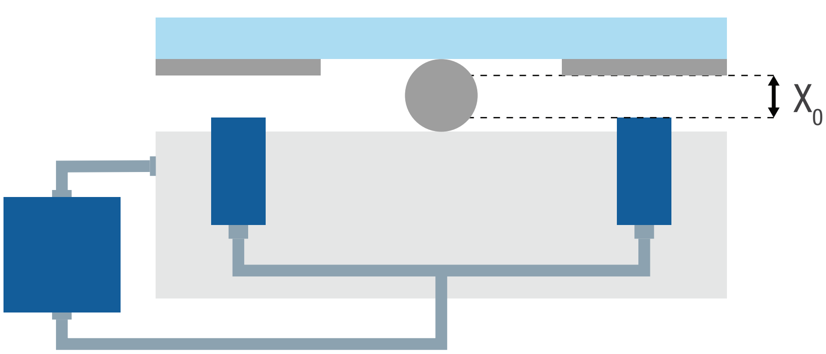
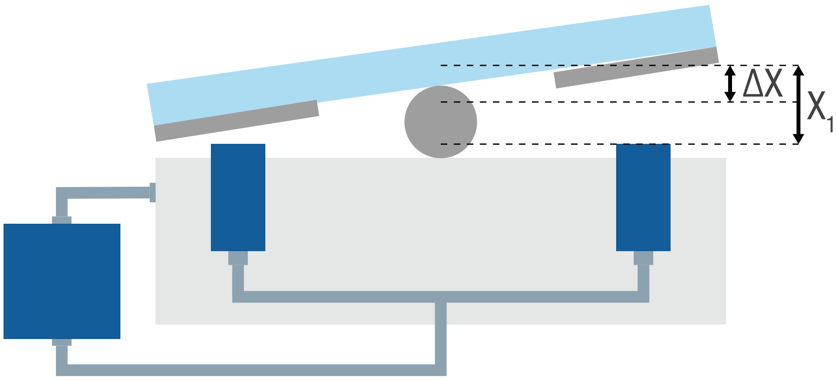


Figure 3 – Final Position



Critical Specifications

A few factors come into play when evaluating an FSM system's performance. First is the bandwidth with which the sensors measure the target, and the driver communicates with the actuators. The higher the bandwidth, the higher the rate at which the mirror moves to the correct position. Next is resolution. Depending on the application, the movements of the mirror need to be on the nanometer scale. Therefore, the sensors must detect target positioning on that scale.

Finally, the conditions in which the system must survive are harsh. Depending on the application, the sensor and driver must be designed to withstand extreme temperatures, operate in vacuum environments, require low power consumption and support both analog and digital outputs. The ideal system must possess a mix of these qualifications, or it may not be enough to complete the job.

Lion Precision's EDA 400 System

Based on these market needs, Lion Precision designed the EDA 400 system. It includes two pairs of sensors (for the X & Y axes) and the driver unit. The system features ultra-high bandwidth, nanometer resolution, digital/analog signal output, low power consumption, and can work in vacuum environments with excellent temperature stability. The EDA 400 is the ideal system for any FSM application, and it can be customized for specific needs. It is also available as a board without an enclosure for space savings and easy integration into a control system.

Ordering Information

Please contact Lion Precision for ordering information.
For additional information on Aerospace applications, click here
We can be reached via email at info@lionprecision.com or via telephone at (651)-484-6544

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