Large-range Single-axis Nanopositioning System

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Team 1, ME450 Winter 2010

Nanopositioning systems provide controlled motion with resolution on the nano-scale. They are critical in many applications including scanning probe microscopy, nano-manufacturing, and hard-disk drive testing. Current nanopositioning technologies can achieve a resolution of 0.02 nm, but are limited to a range of a few hundred microns. We were tasked to design and manufacture a system with a larger range than is currently available utilizing a voice-coil actuator and a flexure bearing for Professor Shorya Awtar and Mr. Gaurav Parmar. Our prototype will be used to test the control systems of our sponsors' current two-axis nanopositioning system. Our nanopositioning system would need to meet the following engineering specifications:

- Single axis motion
- Bearing first natural frequency of 50 Hz
- Range of 10 mm (±5 mm)
- Resolution of 1 nm
- Bi-directional repeatability
- Metrology set-up for characterization of system

We designed a system to achieve these specifications using a moving-magnet two-coil voice-coil actuator coupled with a flexure bearing utilizing double parallelogram flexure units. We have manufactured this system and have achieved single axis motion, range of 10 mm, and a metrology set-up. Further testing is needed to determine the final system resolution and repeatability. We determined that a first natural frequency of 50 Hz was impractical and therefore a bearing first natural frequency of 25 Hz was achieved, which was an improvement of the current two-axis system. The final system prototype is shown below in Figure 1.

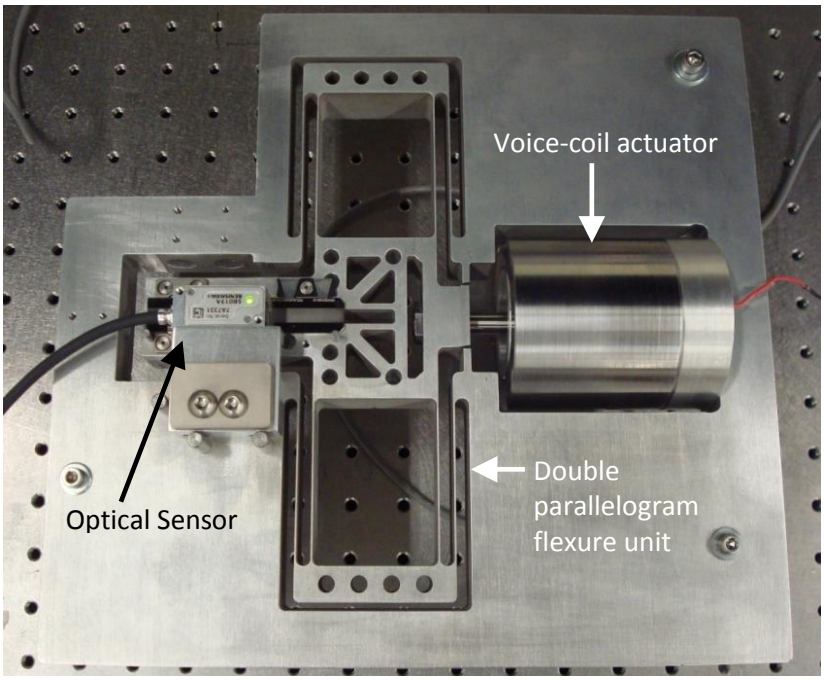

Figure 1. Final System Prototype.