ME Faculty Colloquium

Diamagnetically levitated nanopositioners with large-range and multiple degrees of freedom

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ABSTRACT

Precision positioning stages are indispensable in many areas of science and engineering, particularly for performing manipulation, fabrication, imaging, material characterization, and force control. Compact, multi-degree-of-freedom stages with large dynamic range are especially desirable, but most positioning technologies demand large compromises to be made on one or more of these fronts. In this talk, we will discuss about compact diamagnetically levitated stages to achieve large-range, six degrees-of-freedom positioning. The stages are demonstrated to enable trapping a magnet array in three dimensions (3D), with independent control of the trap stiffness about two axes, independent control of forces in 3D and torque about two axes. A simplified model is proposed to directly relate these physical quantities to the necessary actuation currents. We present experimental results showcasing multi-degree of freedom positioning, with a linear motion range of 5 mm with positioning precision better than 1.88 nm, and angular motion range of 1.1 radian with a resolution of 50 micro-radian. With the volume of the stage being between 10-20 cubic centimeters, its utility as a compact positioner is showcased by using it to automatically replace the tip of an atomic force microscope probe.

ABOUT THE SPEAKER

G. R. Jayanth obtained his B. Tech from IIT Madras in 2002, MS and PhD from The Ohio State University in 2004 and 2008 respectively, all in Mechanical Engineering. Since 2010 he has been with Indian Institute of Science where he is currently an Associate Professor in the Department of Instrumentation and Applied Physics. He is an Associate Faculty in the Department of Mechanical Engineering. His research interests include micro-robotics, precision motion control and microelectromechanical systems (MEMS).

July 22, 2022, 4:00 pm, A R Auditorium, ME@IISc