“Optomechanical Interactions for Micro- and Nano-scale force and displacement sensing”

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Refreshments at 3:30, Upson Hall Lounge

Abstract

Light carries momentum, and hence can apply radiation pressure. A laser pointer applies radiation pressure on a screen, but is too small to be noticed. Radiation pressure becomes important at the micro/nanoscale. Light has been used to control the positions, dynamics, and even stiffness of micro/nanoscale objects.

In this talk, I will discuss my recent progress on radiation pressure based optomechanical interactions, namely fiber based optical tweezers and cavity optomechanics. Different from traditional optical tweezers based on objective lenses, optical fiber based optical tweezers can apply and measure picoNewton level forces at the end of the fiber tips, which can be moved almost anywhere in the solution. The seminar will present the development of fiber optical trapping systems as well as their potential applications in microrheology and cell mechanics study. On the other hand, cavity optomechanical systems typically consist of nanomechanical transducers and integrated optical resonators, where optical resonances and mechanical modes are coupled. This seminar will focus on a Si3N4 tuning fork cavity optomechanical transducer with high fMQM product (6.35*10^12 Hz at the room temperature). Moreover, the stress of the tuning fork is engineered by 3 times the residual film stress through the clamp design, which results in an increase of fM by 1.5 times. This tuning fork optomechanical transducer may find application when both high temporal and force resolution are important, such as in compact sensors for atomic force microscopy.

Biographical sketch

Yuxiang (Shawn) Liu is an assistant professor in Mechanical Engineering, who joined WPI in 2013. He received a Ph.D. in Mechanical Engineering from University of Maryland, College Park in 2011. Before joining WPI, Yuxiang Liu worked as a postdoctoral researcher in Purdue University in 2011. He worked at National Institute of Standards and Technology (NIST) as a NIST-ARRA fellow from 2011 to 2013. His research interests include fiber based optical trapping, silicon nanomechanics and nanophotonics, optofluidics, fiber optical sensors, bioinspired soft robotics, and cell mechanics. His research has been published on journals including Nature Nanotechnology, Physical Review Letters, Optics Letters, and Biomedical Optics Express.