Experimental Study of Novel Untethered Light-driven Microrobots

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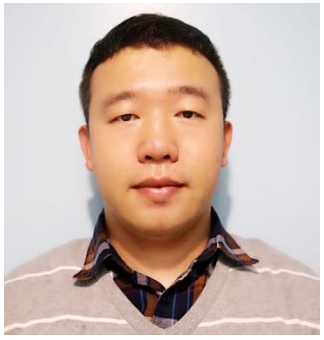
Abstract

The goal of this research is a development of the system of the laser light powered microrobots that can accomplish precision Nano-scale positioning and manipulation tasks. This study will provide fundamentally new knowledge for programming multiactuator locomotors with a single beam, using differential responses of the robot limbs to generate multi-legged gaits. New photo-thermo-mechanical models for the microrobots are formulated, along with proposed new learning control algorithms suitable for physical inter-robot cooperation. To validate the models and control schemes, a unique hardware infrastructure is being prototyped and experimentally demonstrated to drive and test laser-powered microrobots. One type of such a microrobot has flexure legs that can accomplish controlled “stick-slip” motion over a dry surface using a single laser beam, where its gait is controlled by changing laser parameters, such as intensity and pulse frequency. In our experiments, 532nm NdYag pulsed laser with a focused beam (approximately 200μm in diameter) is directed onto the robot using a 2D galvanometer scanning system that can be controlled using NI LabVIEW based interface. Research challenges include selective coatings for the robot body to increase laser energy absorption, coordination of the laser beam positioning with high resolution imaging, and the motion of the microrobot body.

Biography of Presenter

Danming Wei was born in Shenyang, China, in 1987. He received his B.S. degree in Electrical Engineering from Dalian Jiaotong University, China, in 2011, his M.S degree of Chemistry from Western Kentucky University, Kentucky, in 2016 and M.S. degree of Electrical Engineering from University of Louisville, Kentucky, in 2018. Currently, he continues studies pursue Ph.D. degree in Electrical Engineering at University of Louisville. He served as a graduate research assistant in Institute of Combustion Science and Environmental Technology (ICSET) at Western Kentucky University from 2013 to 2016. In 2016, he joined the Next Generation System (NGS) group as a research assistant where he worked in the area of Multiscale Robotics, Microsystems and MEMS control. He represented NGS group at 2017 IEEE International Conference on Robotics and Automation Mobile Microrobotics Challenges and achieved the second place in the final competition.