

The Department of Mechanical Engineering/College of Engineering and Applied
Sciences

Stony Brook University

Mechanical Engineering Seminar

Faculty Candidate



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Institute at Carnegie Mellon University**

Lecture Title: Friction control in snakes and snake robots

Monday, April 07, 2014 at 2PM, Room 173 Light Engineering Building

Abstract

Snakes are one of the world's most versatile organisms, at ease slithering through rubble or climbing vertical tree trunks. Their adaptations for conquering complex terrain thus serve naturally as inspirations for search and rescue robotics. In a combined experimental and theoretical investigation, we elucidate the propulsion mechanisms of snakes on both hard and granular substrates. The focus of this study is on physics of snake interactions with its environment. Snakes use one of several modes of locomotion, such as slithering on flat surfaces, sidewinding on sand, or accordion-like concertina and worm-like rectilinear motion to traverse crevices. First, we develop a series of experiments and supporting mathematical models demonstrating how snakes optimize their speed and efficiency by adjusting their frictional properties as a function of position and time. We then use this discovery to build bio-inspired limbless robots: Scalybot has individually controlled sets of belly scales enabling it to climb slopes of 55 degrees. Finally, to understand how snakes effectively interact with granular substrates, and to design a new control template for robots, we conduct the first study of the detailed mechanics of sidewinding on sand. Our findings will result in developing new functional materials and control algorithms for building effective all-terrain search and rescue robots.

Biography

Hamid Marvi is a postdoctoral fellow in Department of Mechanical Engineering and Robotics Institute at Carnegie Mellon University. He holds two M.S. degrees in Biomedical Engineering and Mechanical Engineering from Sharif University of Technology and Clemson University. He received his Ph.D. in Mechanical Engineering from Georgia Institute of Technology in 2013. Hamid's research focuses on physics of forces when animals and robots interact with complex granular or deformable environments. His work is particularly important for developing effective all-terrain robots for search and rescue and exploratory missions. Hamid has received several fellowships and awards including the Sigma Xi Best Ph.D. Thesis award, TechSTAR award, and the Goizueta graduate fellowship from Georgia Tech and Best Mechatronics Student Paper of the year from the American Society of Mechanical Engineers. Hamid has also been interviewed by numerous television and news agencies interested in his snake research, including New Scientist, Popular Science, IEEE Spectrum, Discovery News, Inside Science, and Science Daily.

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