IOWA STATE UNIVERSITY
Department of Mechanical Engineering

Snakes on a Sandy Plane

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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 and exploratory robotics. Snakes can utilize several modes of locomotion, such as slithering on flat surfaces, sidewinding on sand, or accordion-like concertina and worm-like rectilinear motion. Unique frictional properties of snakes are the key to their effective locomotion using these gaits. Passive structures contributing to frictional properties of snakes have been widely studied. However, there is lack of understanding on many active mechanisms snakes use to control their friction and drag forces during their different modes of locomotion. In this talk, I will first present a series of experiments and supporting mathematical models to discuss the physics of forces when snakes actively interact with complex hard or granular environments. Next, bio-inspired limbless robots with active control of friction and drag developed at Georgia Tech and Carnegie Mellon University will be introduced. Special attention will be given to sidewinding of snakes and snake-robots on sandy hills. Finally, several active and passive designs for control of fibrillar adhesion and friction as well as a new technique for programming frictional surfaces will be discussed. The findings of these studies will result in developing adaptive attachment structures and control algorithms towards effective all-terrain search and rescue and exploratory robots.

Biography
Hamid Marvi is a postdoctoral fellow and a lecturer in Department of Mechanical Engineering at Carnegie Mellon University. He holds two M.S. degrees in Biomedical Engineering and Mechanical Engineering from Sharif University of Technology and Clemson University, respectively. He received his Ph.D. in Mechanical Engineering from Georgia Institute of Technology in 2013. Hamid's research focuses on developing bio-inspired mechanisms for active control of frictional, adhesive, and drag forces. His work is particularly crucial for developing effective all-terrain robots for search and rescue and exploratory missions in unstructured and unpredictable terrain. 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. He has also received Best Mechatronics Student Paper of the year from the American Society of Mechanical Engineers in 2012. Hamid has published papers in *Science*, *Journal of the Royal Society Interface*, and several other scientific journals. His work has received much media attention from scientific media such as *Science Now*, *IEEE Spectrum*, *Scientific American*, *Popular Science*, and *New Scientist* as well as popular media such as *New York Times*, *Los Angles Times*, *Washington Post*, and *BBC*.

This seminar counts towards the ME 600 seminar requirement for Mechanical Engineering graduate students.

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