Mechanical Engineering
Carnegie Mellon

Insects as models for robot mobility and autonomy: Walking, running, climbing and flying

presented by

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We are using intelligent biological inspiration to incorporate neuromechanical principles of locomotion and autonomy into robot designs. The goals are to develop useful legged robots and also to use those robots as models to help us better understand animals. A robot that captures the leg designs important for cockroach locomotion will be extremely agile and therefore suitable for many missions. For example, the after action report for the robot search and rescue mission at the World Trade Center recommends that legs be used instead of tracks or wheels because they can better adapt to complex terrain. However, before a robot with the intricate leg designs of an animal can be deployed some technical issues must be solved. Therefore, we are using two complementary approaches to develop legged robots. Using the direct approach we have developed a series of robots that are each more similar to cockroach. These have multi-segmented legs requiring a controller that captures neurobiological principles. In the more abstracted approach the fundamental principles of cockroach locomotion are applied using existing technologies and in a simplified manner. Their motor control is also simplified and the agility of these vehicles makes them suitable for many applications in the near term. They are currently being used as sensory platforms to research guidance and navigation strategies. The WTC report also recommended that search and rescue robots should be capable of autonomous locomotion. We are planning to develop an artificial insect head with sensors and a guidance and stabilizing system for implementation in our small mobile robots. Our preliminary research resulted in a robot autonomously climbing obstacles using tactile antennae and avoiding obstacles using ultrasonic sensors in a bat-inspired configuration.

Roger D. Quinn, Ph.D.

Roger D. Quinn is the Arthur P. Armington Professor of Engineering at Case Western Reserve University. He joined the Mechanical and Aerospace Engineering department in 1986 after receiving a Ph.D. (1985) from Virginia Tech. He has directed the Biorobotics Laboratory since its inception in 1990. His research is devoted to the development of robots and control strategies based upon biological principles. He has 200 publications and several patents. His biology-engineering collaborative work on behavior based distributed control, autonomous robot climbing, and human-machine interfacing have each earned IEEE awards. He is the lead inventor of a group of vehicles that benefit from abstracted biological principles. These patented vehicles called Whegs™ run rapidly and climb in an insect like manner and are ready for near-term use in real world missions. His current work includes developing intelligent systems to increase the autonomy of mobile robots.

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10:00 am - 10:30 am Refreshments in Scaife Lobby

10:30 am - 11:30 pm Seminar in Scaife 125

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