Electrical & Computer ENGINEERING

SEMINAR

THURSDAY
MARCH 20, 2008

Scaife Hall Auditorium
Room 125

4:30 p.m.
Refreshments—4:00 p.m.

Metin Sitti
ASSOCIATE PROFESSOR
CARNEGIE MELLON UNIVERSITY

Metin Sitti received the BSc and MSc degrees in electrical and electronics engineering from Bogazici University, Istanbul, Turkey, in 1992 and 1994, respectively, and the PhD degree in electrical engineering from the University of Tokyo, Tokyo, Japan, in 1999. He was a research scientist in the Department of Electrical Engineering and Computer Sciences, University of California at Berkeley during 1999-2002. He is currently an associate professor in the Department of Mechanical Engineering with joint appointments in the Robotics Institute, Electrical and Computer Engineering, and Biomedical Engineering at Carnegie Mellon. He is the director of the NanoRobotics Laboratory. His research interests include miniature mobile robots, biologically inspired micro/nanosystems, and micro/nanoscale manipulation and manufacturing systems.

He has been appointed as the Adamson Career Faculty Fellow in 2007. He received the National Science Foundation CAREER award and the CMU Struminger award in 2005. He was invited as a speaker to the National Academy of Sciences, Keck Foundation Life Engineering Symposium in 2005. He was elected as the Distinguished Lecturer of the IEEE Robotics and Automation Soceity for 2006-2008. He received the second prize in the World RoboCup Nanogram Demonstration League (2007), the best biomimetics paper award in the IEEE Robotics and Biomimetics Conference (2004), the best paper award in the IEEE/RSJ International Conference on Intelligent Robots and Systems (1998), and the best video award (2002) in the IEEE Robotics and Automation Conference. He is the Vice President of the Technical Activities in the IEEE Nanotechnology Council for 2008-2010, and he is the co-editor-in-chief of Journal of Micro/Nano-Mechatronics and an associate editor for the IEEE Trans. on Robotics.

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Miniature Mobile Robots Down to Micron Scale

Miniature robots have the unique capability of accessing to small spaces and scales directly. Due to their small size and small scale physics and dynamics, they are agile and portable, and could be inexpensive and in large numbers if they are mass produced. Different scale miniature robots with various locomotion capabilities and target applications are presented in this talk. These miniature robots could revolutionize health-care, mobile sensor networks, environmental monitoring, space, search and rescue, security, entertainment, and education applications.

At the mesoscale (palm-size or cm-scale), first, miniature climbing robots using elastomer fibrillar adhesives inspired by gecko and insect foot-hairs as their repeatable and efficient attachment mechanism are proposed. Modeling, fabrication, and characterization of such elastomer fibrillar adhesives are demonstrated. Tri-legged and tank-style climbing robot prototypes show the feasibility of fibrillar adhesives based climbing on smooth and micro/nanoscale rough surfaces in air or vacuum. Next, an endoscopic pill size capsule robot is proposed to clamp inside intestines using oil coated fibrillar adhesives coated on robot leg footpads for minimally invasive potential gastrointestinal tract therapeutic applications. Finally, two new legged miniature robots walking and running on water surface inspired by water strider insects and basilisk lizards, respectively are presented towards unique amphibious robotic locomotion capabilities at the small scale.

Going down to tens or hundreds of micron scale robots, significant bottlenecks are on-board actuation principles and power sources. As two alternative approaches, first, external magnetic actuation is used to move hundred micron scale permanent magnet robot bodies on planar surfaces in air or in liquid in 2-D autonomously. Next, a hybrid (biotic/abiotic) actuation principle is used to propel micron scale robotic bodies in liquid by harvesting the flagellar propulsion of attached bacteria and the chemical energy in the environment. On/off propulsion control of such stochastic hybrid micro-robots is demonstrated using chemical stimulus where heavy metal cupper ions hinder their propulsion while ethylenediaminetetraacetic acid resumes their motion.

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