



Robotics 2.0 - The Co-Robotic Revolution and Implications for Innovation and Human Well-Being

Thursday, April 3, 2014

Seminar: 2:00 p.m. - 3:00 p.m.

Reception: 3:00 p.m. - 3:30 p.m.

Missouri-Ozark Room, Havener Center



Dr. Richard Voyles, Associate Dean for Research College of Technology Purdue University

Robotics and Cyber-Physical Systems are ushering in a new age of engineering design with new techniques and new materials. The old way of design in which we assume decoupled, low-order, block-diagonal models is breaking down at all levels and all scales. In addition, the human element is increasingly important as an active participant in these coupled systems. In this talk, I overview a range of research directions my lab has taken over the years from search and rescue robots - artifacts that assist humans in disasters, to heterogeneous wireless control networks - infrastructure that assists programmers in distributed control, to structured computational polymers - meta-materials that assist designers with new artifacts.

Starting with some of the artifacts we've developed, I'll describe the CRAWLER and the MOTHERSHIP - robots for extending human reach in collapsed-structure search and rescue. One at the small end of the spectrum and one at the large, these mechatronic designs share a common principle: differential drive to "conserve" mechanism. At their computational core is the RecoNode, a custom node for high performance wireless control networks. These infrastructural nodes extend our self-adaptive architecture to include both reconfigurable software and reconfigurable hardware. Based on our Port-Based Object/Real-Time OS (PBO/RT), we are developing tools for software code migration and hardware partial dynamic reconfiguration to realize an embedded virtual machine that simplifies hardware-independent distributed control design, unifying the paradigms of design to leverage human creative engineering.

Finally, we are using shape deposition manufacturing techniques to produce 1-D, 2-D and 3-D polymer building blocks that incorporate sensing, actuation, cognition, and structure into convenient, specifiable smart materials. Our cognitive architecture is based on fully-interconnected Synthetic Neural Networks, which implement parallel artificial neurons from polymer electronics.

Dr. Voyles has been involved in robotics and cyber-physical systems most of his academic and professional life. He is currently the Associate Dean for Research in the College of Technology at Purdue University as well as the founding director of the Purdue Robotics Accelerator. Concurrently, he is serving the Office of Science and Technology Policy (OSTP) at the White House as Assistant Director of Robotics and Cyber-Physical Systems. Prior to this appointment, he was lead Program Director at the National Science Foundation running the National Robotics Initiative (NRI) and was one of the founding PDs of the Innovation Corps (I-Corps) program. Prof. Voyles' formal training mirrors the pillars of robotics, having received the B.S. in Electrical Engineering from Purdue University in 1983, the M.S. in Manufacturing Systems Engineering from the Department of Mechanical Engineering at Stanford University in 1989, and the Ph.D. in Robotics from the School of Computer Science at Carnegie Mellon University in 1997. He has been Associate Professor of Computer Science at the University of Minnesota and Associate Professor of Electrical and Computer Engineering at the University of Denver as well as Site Director of the NSF Safety, Security, and Rescue Research Center, an NSF I/UCRC. Dr. Voyles' research interests are in the areas of robotics and artificial intelligence. Specifically, he is interested in the development of small, resource-constrained robots and robot teams for urban search and rescue and surveillance as well as new generations of materials and co-robots for intelligent, human-assistive tasks. Dr. Voyles has additional expertise in sensors and sensor calibration, particularly haptic and force sensors, and real-time control. Dr. Voyles' industrial experience includes Dart Controls, IBM Corp., Integrated Systems, Inc., Avanti Optics and Mark V Automation Corp. He has also served on the boards of various start-ups and non-profit groups.