Shinshu University
GCOE Special lecture
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Adaptive and Reconfigurable Robotic and Embedded Systems

Speaker: Dr. Harry H. Cheng, Professor
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Location: , Japan

Abstract:

Adaptive and reconfigurable systems are becoming increasingly popular. They can rapidly respond to changes of external environment. This seminar discusses design and programming of adaptive and reconfigurable systems, which face challenges in many novel ways. First, as an example of adaptive and reconfigurable systems, design of an intelligent reconfigurable modular robot called iMobot will be presented. iMobot has four controllable degrees of freedom. It can move with a variety of locomotion, including inch-worm, turning, driving, arched driving, and driving with a reduced profile. Multiple iMobot can be reconfigured into morphologically different robots such as a trunk, snake, or humanoid robot. Highly reconfigurable modular robots such as iMobot face unique control and programming challenges due to the high level of reconfigurability and a large number of controllable degrees of freedom in the system.

Second, an embeddable C/C++ interpreter called Ch for *in-situ* programming of adaptive and reconfigurable systems such as iMobot is presented. Ch is a superset of C with classes in C++. Many new features, such as complex numbers, variable length arrays (VLAs), and generic functions, first implemented in Ch became part of the latest C standard called C99 to make C more suitable for applications in engineering and science. In addition, Ch contains all salient features of MATLAB for graphical plotting and numerical computing. Mobile agent technology is also emerging as a key concept in building adaptive and reconfigurable systems. It allows deployment and execution of mobile code dynamically in response to events unanticipated at the design stage for adaptive and reconfigurable systems. In this seminar, the design and implementation of an open-source mobile agent system called Mobile-C is presented. The C/C++ interpreter Ch is embedded into Mobile-C to handle mobile C/C++ agent code. Mobile-C supports both stationary and mobile agents, and is especially designed to support C/C++ mobile agents for adaptive and reconfigurable systems.

As a C/C++ interpreter, Ch is very user friendly. Finally, how to use C/C++ interpreter for teaching introductory computer programming in C is illustrated.

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About the Speaker:

Harry H. Cheng is a Professor in the Department of Mechanical and Aerospace Engineering, Graduate Group in Computer Science, and Graduate Group in Electrical and Computer Engineering at the University of California, Davis. He is also the Director of the Integration Engineering Laboratory (http://iel.ucdavis.edu) at the University of California, Davis. Before joining the faculty at the University of California, Davis, he worked as a Senior Engineer on robotic automation systems in the Research and Development Division at United Parcel Service from 1989 to 1992. He is the founder of SoftIntegration, Inc. which provides infrastructure software and services for rapid development and deployment of application software. He received the M.S. degree in Mathematics in 1986 and the Ph.D. degree in Mechanical Engineering in 1989 from the University of Illinois at Chicago.

Dr. Cheng has been teaching computer programming in C for engineering applications, engineering software design, robotics, and computer-aided design at the University of California, Davis since 1992. His research is focused on computer-aided engineering, mobile agent-based computing, intelligent mechatronic and embedded systems, robotics, and innovative teaching. He has published over 160 papers in refereed journals and conference proceedings. He is the author of the book entitled *"C for Engineers and Scientists: An Interpretive Approach"* published by McGraw-Hill in 2009 (http://iel.ucdavis.edu/cfores). He received a Research Initiation Award from the National Science Foundation, the Best Paper Award at the IEEE/ASME International Conference on Mechatronic and Embedded Systems and Applications, the Procter and Gamble Best Paper Award as well as the Waldron Award at the Applied Mechanisms and Robotics Conferences. He received an Outstanding Contribution Award from United Parcel Service Inc.

Dr. Cheng is the original designer and implementer of an embeddable C/C++ interpreter Ch (http://www.softintegration.com) for cross-platform scripting, shell programming, two- and three-dimensional plotting, numerical computing, and embedded scripting. His C/C++ interpreter has been well received in both academia and industry. His group developed a mobile agent platform called Mobile-C (http://www.mobilec.org) for supporting C/C++ mobile agents in networked intelligent mechatronic and embedded systems. Dr. Cheng participated in revision of the latest C standard called C99 through ANSI X3J11 and ISO S22/WG14 C Standard Committees and made contributions to new C99 numerical features of complex numbers, variable length arrays, and IEEE floating-point arithmetic, which had been implemented in his C/C++ interpreter Ch. Ch provided proof of concept implementations for the C99 standardization process.

Dr. Cheng is a Fellow of ASME and a Senior Member of IEEE. He has presented tutorials on real-time Linux for the control of mechatronic systems at the ASME IDETC. He is the Founding Chair of the Technical Committee on Mechatronic and Embedded Systems and Applications in the Design Engineering Division of ASME. He was the Chair of the Technical Committee on Mechatronic and Embedded Systems in ITS of the IEEE Intelligent Transportation Systems Society. He was the Chair of the Technical Area of Embedded and Ubiquitous Computing and Chair of Technical Area of Computers in Electromechanical Systems in the ASME Division of Computers and Information in Engineering. He served as the General Chair and Program Chair of the IEEE/ASME International Conference on Mechatronic and Embedded Systems and Applications.