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DEPARTMENT OF MECHANICAL ENGINEERING
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SPRING 2007 SEMINAR SERIES: JOINT SEMINAR WITH DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING

Date: Friday, April 13, 2007
Time: 11:00 am - 12:00 pm
Room: SL 165

Reception at 10:45 am (cookies and refreshments served)
Everyone is invited

Nonlinear Adaptive Robust Control –Theory and Applications

Dr. Bin Yao, Professor, School of Mechanical Engineering, Purdue University

Abstract. This talk will present a theoretically solid nonlinear adaptive robust control (ARC) approach that well reflects what a human brain normally does -- seamless integration of the fast reaction to immediate feedback information and the slow learning utilizing large amount of stored past information that is available in the computer based control systems -- to synthesize performance oriented controllers with built-in intelligences under practical constraints. The first half of the seminar focuses on the basic ideas of ARC strategy and touches some specific design issues. The constructed ARC controllers range from the full-state feedback ARC for MIMO nonlinear systems in semi-strict feedback forms and the nonlinear observer based ARC for a class of nonlinear systems with partial state feedback to the output feedback ARC for uncertain linear systems with bounded disturbances. The second half the seminar focuses on the applications of the proposed ARC approach to the intelligent and precision control of several electro-mechanical/hydraulic systems. The applications include the precision motion control of linear motor driven high-speed/high-acceleration electro-mechanical devices (e.g., machine tools) for precision manufacturing, the motion and pressure control of electro-hydraulic systems (e.g., industrial hydraulic excavators), the energy-saving control of electro-hydraulic systems via novel programmable valves, and the coordinated motion and force tracking control of robot manipulators in contact with various contacting surfaces. In particular, experimental results on the precision motion control of a linear motor driven industrial gantry system will be shown to illustrate the high performance nature of the proposed ARC approach.

About the Speaker. Bin Yao received his Ph.D. degree in Mechanical Engineering from the University of California at Berkeley in 1996, the M.Eng. degree in Electrical Engineering from the Nanyang Technological University, Singapore, in 1992, and the B.Eng. in Applied Mechanics from the Beijing University of Aeronautics and Astronautics, P.R.China, in 1987. Since 1996, he has been with the School of Mechanical Engineering at Purdue University and was promoted to the rank of Associate Professor in 2002, and Professor in 2007. Dr. Yao was awarded a Faculty Early Career Development (CAREER) Award from the National Science Foundation (NSF) in 1998 for his work on the engineering synthesis of high performance adaptive robust controllers for mechanical systems and manufacturing processes. His research interests include the design and control of intelligent high performance coordinated control of electro-mechanical/hydraulic systems, optimal adaptive and robust control, nonlinear observer design and neural networks for virtual sensing, modeling, fault detection, diagnostics, and adaptive fault-tolerant control, and data fusion. He has published over 120 technical papers. He is the recipient of the O. Hugo Schuck Best Paper (Theory) Award from the American Automatic Control Council in 2004. He has been actively involved in various technical professional societies such as ASME and IEEE. He currently serves as the vice-chair of the ASME DSCD Mechatronics Technical Committee that he initiated in 2005. He was a technical editor of the IEEE/ASME Transactions on Mechatronics from 2001 to 2005, and is currently an Associate Editor of the ASME Journal of Dynamic Systems, Measurement, and Control.