IOWA STATE UNIVERSITY
Department of Mechanical Engineering

A Hierarchical Approach to Control of Complex Energy and Power Systems for Air Vehicles

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Abstract

This talk will present a particular hierarchical approach to energy and power flow in air vehicles that accommodates multiple power modes. These modes can be thermal, fluid, electrical, or mechanical. A key challenge in working across various modes of power flow is the widely varying time scales. The hierarchy allows for systems operating on different time scales to be coordinated in a controllable manner. It also allows for different dynamic decision making tools to be used at different levels of the hierarchy based on the needs of the physical systems under control. Additional advantages include the modularity and scalability inherent in the hierarchy. Additional modules can be added or removed without changing the basic approach.

In addition to the hierarchical control, a particularly useful graph-based approach will be introduced for the purpose of modeling the system interactions. The graph approach, like the hierarchy, has benefits of modularity and scalability along with being an efficient framework for representing systems of different time scales. Recent results will be presented representing both generic interconnected complex systems as well as specific examples and resulting benefits.

Professor Alleyne received his Mechanical and Aerospace Engineering B.S.E. from Princeton University in 1989. He received his M.S. and Ph.D. degrees in Mechanical Engineering in 1992 and 1994, respectively, from UC Berkeley. He joined the University of Illinois, Urbana-Champaign in 1994. He currently holds the Ralph M. and Catherine V. Fisher Professorship in the College of Engineering and is the Director for the NSF Engineering Research Center on Power Optimization for Electro-Thermal Systems (POETS). He is the recipient of an NSF CAREER award, has been an IEEE Distinguished Lecturer, and a National Research Council (NRC) Associate. He is a Fellow of IEEE and ASME. He has received the Gustus Larson Award, the Charles Stark Draper Award for Innovative Practice, The Yasundo Takahashi Education Award and the Henry Paynter Outstanding Investigator Award from ASME. The American Automatic Control Council awarded him the Control Engineering Practice Award. He was a Fulbright Fellow to the Netherlands and has held visiting Professorships at TU Delft, University of Colorado, ETH Zurich, and Johannes Kepler University. He has held several editorial positions for ASME, IEEE, and the International Federation of Automatic Control and been active in external advisory boards for universities, industry and government including the Scientific Advisory Board for the U.S. Air Force and the National Academies Board On Army Research and Development. He chaired the ASME Dynamic Systems and Controls Division and is a member of the IEEE Controls Systems Society Board of Governors. His record of campus service includes the Associate Dean for Research in the College of Engineering and the Associate Head for Undergraduate Programs in Mechanical Science and Engineering. In addition to research and service, he has a keen interest in education and has earned the UIUC College of Engineering Teaching Excellence Award, the UIUC Campus Award for Excellence in Undergraduate Education and the UIUC Campus Award for Excellence in Graduate Student Mentoring.

This seminar counts towards the ME 600 seminar requirement for Mechanical Engineering graduate students.

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