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A Systems Approach to Modeling, Control, and Design for Electrified Mobility

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ABSTRACT:

We live in an increasingly electrified world. For stationary applications such as industry and manufacturing, this statement has been obvious since the start of the 20th century as steam and belt drives in factories gradually gave way to electric motors for machining, conveyor lines, and all manner of other industrial applications. Now we are seeing a dramatic rise in the electrification of mobility systems. The progress has been steady for several decades but it is really during the past several years that electrified mobility has seen a rapid growth at the level of individual consumer. Interestingly, this growth cuts across widely varying modes of mobility; from individual bicycles to on-highway vehicles to large ships and aircraft. This talk will detail some of the technical challenges related to Modeling, Control and Design. Of high relevance to systems and controls audiences is the interplay between modes of power distribution within electrified mobility systems. This includes the flow of power, or storage of energy, in the mechanical, chemical, electrical, and thermal domains. For example, power flow in the electrical domain can be constrained by component temperature limits in the thermal domain. Several examples of challenges will be raised along with some solutions for specific problems of Modeling, Control, and Design in electrified mobility. The presented solutions will be integrated such that the chosen modeling tools are specifically amenable to both the control and design challenges. Simulation and experimental results will be presented that demonstrate a superior overall mobility platform performance when a systems approach is taken.

BIOGRAPHY:

Dr. Andrew Alleyne received the B.S. in Mechanical and Aerospace from Princeton University in 1989, and the M.S. and Ph.D. degrees in Mechanical Engineering from the University of California at Berkeley in 1992 and 1994, respectively. He is currently the Dean of the College of Science and Engineering at the University of Minnesota, Twin Cities where he oversees 12 departments and over 8,000 students. He also holds the Russell and Elizabeth Bennett Chair at the University of Minnesota. Prior to that he was a faculty member at the University of Illinois, Urbana-Champaign where he was the inaugural Director for the NSF Engineering Research Center (ERC) on Power Optimization for Electro-Thermal Systems. He is a Fellow of IEEE, ASME and AAAS and is also a member of the U.S. National Academy of Engineering. He was a Fulbright Fellow to the Netherlands where he held a Visiting Professorship at TU Delft. He has also held visiting professorships at the University of Colorado at Boulder, Johannes Kepler University in Austria, and ETHZ in Zurich. His research background encompasses the modeling, simulation, and implementation of control systems for complex systems and nonlinear systems. He has been active in external advisory boards for universities, industry and government including the U.S. Air Force, U.S. Army, U.S. Navy and the Department of Energy. In addition to research and service leadership, he has always had a keen interest in education and earned the UIUC College of Engineering's Teaching Excellence Award, the UIUC Campus Award for Excellence in Undergraduate Education, and the UIUC Campus Award for Excellence in Graduate Student Mentoring.