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Integrated Power Systems for Electrified Vehicles and Ships: Real-time Energy Management and Optimization



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ABSTRACT:

Integrated power systems (IPS) incorporate heterogeneous power sources, including energy storage systems, to achieve improved energy efficiency and reliability. They have been a critical enabling technology for vehicle electrification, particularly for all-electric ships. One special characteristic of IPS is the highly interactive and dynamic nature, due to tight physical couplings of the multiple components involved. To achieve high efficiency, one often exploits their operating profiles and pushes these systems to operate on or close to their admissible boundary, thereby calling for predictive control.

In this presentation, we will explore the special characteristics of the IPS and discuss the challenges and solutions of predictive control applied to this special class of systems. On the methodology side, we will present the integrated perturbation analysis and sequential quadratic programming (IPA-SQP) algorithm that was developed to deal with the fast and interactive dynamics of IPS. On the application side, we will cover several examples, including the IPS for all-electric ships and the integrated solid oxide fuel cell and gas turbine (SOFC/GT) system.

BIOGRAPHY:

Jing Sun received her Ph. D degree from the University of Southern California in 1989, and her master and bachelor degrees from the University of Science and Technology of China in 1984 and 1982. From 1989-1993, she was an assistant professor in the Electrical and Computer Engineering Department at Wayne State University. She joined Ford Research Laboratory in 1993, where she worked on advanced powertrain system controls. After spending almost 10 years in the industry, she came back to academia in 2003 and joined the University of Michigan where she is the Michael G. Parsons Collegiate Professor and the chair in the Naval Architecture and Marine Engineering Department. She also holds joint appointments in the Electrical Engineering and Computer Science Department and Mechanical Engineering Department at the same university. She holds 41 US patents and is a Fellow of the National Academy of Inventors. She co-authored (with Petros Ioannou) a textbook on Robust Adaptive Control and has published over 250 archived journal and conference papers. She is a Fellow of NAI (National Academy of Inventors), IEEE and SNAME (the Society of Naval Architecture and Marine Engineering). She is one of the three recipients of the 2003 IEEE Control System Technology Award.