

COLLEGE OF ENGINEERING

Control Seminar



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Battery Control Engineering (A Really Dry Run of a CDC 2017 Plenary)



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Friday, December 1, 2017

3:30 – 4:30 pm • 1500 EECS

ABSTRACT: The 25th anniversary of the commercialization of lithium-ion batteries marks their wide-spread use in handheld consumer electronics and coincides with a period of intense efforts for powering electric vehicles. Managing the potent brew of lithium ions in the large quantities necessary for vehicle propulsion is anything but straightforward. From spacecraft probes landing billion miles away from Earth to the daily commute of a hybrid electric automobile, they all require sophisticated battery management systems (BMS) based on control engineering tools. The BMS is the brain of the battery system and is responsible for State of Charge (SOC), State of Health (SOH) and State of Power (SOP) estimation. The BMS relies on accurate prediction of complex electrochemical, thermal and mechanical phenomena. This raises the question of model and parameter accuracy. Moreover, if the cells are aging, which parameters should we adapt after leveraging limited sensor information from the measured terminal voltage and sparse surface temperatures? With such a frugal sensor set, what is the optimal sensor placement? To this end, control techniques and novel sensors that measure the cell swelling during lithium intercalation and thermal expansion will be presented. We will conclude by highlighting the fundamental difficulties that keep every battery control engineer awake, namely predicting local hot spots, detecting internal shorts, and managing the overwhelming energy released during a thermal runaway.

BIO: Anna G. Stefanopoulou is the William Clay Ford Professor of Manufacturing at the Mechanical Engineering Department at the University of Michigan. She is an ASME and an IEEE Fellow, elected member of the ASME DSCD executive committee and the IEEE Control System Society Board of Governors. She was the founding chair of the ASME DSCD Energy Systems Technical Committee and a member of a National Research Council committee on the 2025 US Vehicle Fuel Economy Standards. She has collaborated with numerous brilliant UMICH students co-authoring a book on Control of Fuel Cell Power Systems, 15 US patents, 5 best paper awards and more than 250 publications on estimation and control of internal combustion engines and electrochemical processes such as fuel cells and batteries.