The Center for Control, Dynamical Systems, and Computation
University of California at Santa Barbara
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Presents

Applying Simple Control Techniques in Fuel Cell Systems

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Abstract:
Periods of transient operation during start-up, shut-down, and sudden load changes are characteristic and ubiquitous to all power producing devices. During these critical periods, fuel cell systems rely on monitoring and controlling devices and methodologies. In this talk we present how simple model-based control, optimization and estimation techniques can be used to improve the performance and robustness of Polymer Electrolyte Membrane (PEM) fuel cells. First, fundamental limitations in controlling the reactant flow of power-autonomous fuel cells will be discussed. These results provide insight on practical control strategies and calibration of fuel cell hybrid electric vehicles. Optimization tools will then be used to determine the required fuel cell-battery sizing (hybridization level) and the associated trends in fuel economy. Finally, we focus on the water management problem, and specifically, the need for controlling the water distribution inside the gas diffusion layers of PEM fuel cells. We show how time-scale decomposition allowed us to approximate the two-phase, reaction-diffusion, spatially distributed water dynamics and consequently establish a feasible boundary value control problem. Validation results using detailed liquid water prediction with neutron imaging and aggregated multi-cell stack voltage responses are also presented.

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About the Speaker:
Anna G. Stefanopoulou obtained her Diploma (1991, Nat. Tech. Univ. of Athens, Greece) in Naval Architecture and Marine Engineering and her Ph.D. (1996, University of Michigan) in Electrical Engineering and Computer Science. She is a professor of mechanical engineering at the University of Michigan. She was an assistant professor (1998-2000) at the University of California, Santa Barbara, and a technical specialist (1996-1997) at Ford Motor Company.