



Power Systems Engineering Research Center

Aggregated Electricity Load Modeling & Control for Regulation and Load Following Ancillary Services

Duncan Callaway

Assistant Professor of Energy and Resources and Mechanical Engineering
University of California, Berkeley

PSERC Public Tele-Seminar

November 3, 2009

2:00-3:00 p.m. Eastern Time (11:00-12:00 p.m. Pacific)

Description:

This talk will present new methods to model and control the aggregated power demand from a population of thermostatically controlled loads. The control objective is to produce relatively short time scale responses (hourly to sub-hourly) for ancillary services such as load following and regulation. The control signal is applied by manipulation of temperature set points. The methods leverage the existence of system diversity and use physically-based load models to inform the development of a new theoretical model that accurately predicts – even when the system is not in equilibrium – changes in load resulting from changes in thermostat temperature set points. Insight into the transient dynamics that result from set point changes is developed by deriving a new exact solution to a well-known hybrid state aggregated load model. A straightforward minimum variance control law is developed and it is shown that the high frequency components of the output of a wind plant can be followed with very small changes in the nominal thermostat temperature set points.

Biography: **Duncan S. Callaway** obtained his Ph.D. in theoretical and applied mechanics from Cornell University, Ithaca NY, USA in 2001, and his B.S. in mechanical engineering from the University of Rochester, NY, USA in 1995. He is currently an Assistant Professor of Energy and Resources and Mechanical Engineering at the University of California, Berkeley. Prior to joining the University of California, he was first an NSF postdoctoral fellow in the Department of Environmental Science and Policy at the University of California, Davis, subsequently worked as a Senior Engineer at Davis Energy Group, Davis, CA, USA and PowerLight Corporation, Berkeley CA, USA, and was most recently a Research Scientist at the University of Michigan. His current research interests are in the areas of power management; modeling and control of aggregated storage devices; spatially distributed energy resources; environmental impact assessment of energy technologies.

Related PSERC webinars:

[Effects of Ancillary Service Markets on Frequency and Voltage Control Performance of Deregulated Power Systems](#) (09-06, April 21, 2009)

[Security Enhancement through Direct Non-Disruptive Load Control](#) (06-07; April 18, 2006)

Speaker Contact Information

Duncan Callaway
dcal@berkeley.edu
510-642-1640

Participation by Webcast: You can participate in PSERC tele-seminars via webcast. Before the tele-seminar, [click here](#) and then on 11/3/09 when the status is "In Progress." Note that the web page at that address does not automatically refresh. The webcast will include the audio and the slides so you will not have to download the slides in advance. If you want to ask questions, you should register for participation by phone. The archived audio-slide production of the tele-seminar will be available for [webstreaming](#) after the tele-seminar.

Registration for Webcast Participation: None required. There is no charge for participating!

Participation by Phone: Live audio will also be provided via a teleconference phone bridge. After registering, you will be sent connection information for the conference phone bridge. You will need to download the presentation slides in advance of tele-seminar. The presentation slides will be posted on November 3 on the [PSERC website](#).

Registration for Phone Participation: To indicate that your organization would like to have a phone access line, send an email to Theresa.Herr@asu.edu with the subject "Callaway Seminar". To use our limited phone bridge capacity efficiently, we ask that people within an organization participate together rather than calling in separately, if at all possible. Connection information will be sent before the tele-seminar. There is no charge for participating!

Professional Development Hour Certification: PDH certification is available for PSERC members (only). Send an email requesting PDH certification to Theresa.Herr@asu.edu with the subject "PDH" after the seminar. *Include the name and title of each participant.*

Assistance

If you have any questions, please contact Theresa Herr, PSERC's administrative assistant, at 480-965-1643 or Theresa.Herr@asu.edu. You can also contact Dennis Ray, PSERC Executive Director, at 608-265-3808 or djray@engr.wisc.edu.

PSERC's Tele-Seminar Coordinator

Shmuel Oren, University of California at Berkeley
Email: oren@ieor.berkeley.edu

Shmuel welcomes feedback on the tele-seminars and suggestions for future ones.