FEEDER Foundations for Engineering Education for Distributed Energy Resources

Spring 2019 Seminar Series

Real-time, scalable coordination of flexible demand with packetized energy management

FRIDAY MARCH 1, 2019

02:00 PM EDT – HEC 356

Abstract: Packetized Energy Management (PEM) has recently emerged as a novel mechanism for aggregating and coordinating DERs, such as electric water heaters, electric vehicles, and electric battery storage, at scale. PEM leverages key concepts from communication systems that today enable billions of people to access the internet and adapts these concepts to managing DERs. In the same way that a bulky data file gets split up into smaller data packets, PEM delivers an electric water heater's energy need in multiple small energy packets rather than a single "bulky" delivery. Under PEM, local packet-based control enables heterogeneous DERs to asynchronously request energy packets from a demand coordinator, who can then choose to accept or deny the packet requests in real time. By modulating the rate of accepting packet requests from a fleet of water heaters, the grid operator (or demand coordinator) can then dispatch the aggregate demand as if it was a bulk battery. With PEM's bottom-up framework, we overcome complications with modeling and estimating the complex end-consumer usage patterns and can guarantee privacy and comfort for the end-consumer, which makes PEM particularly promising for managing diverse and heterogeneous resources. The talk will cover modeling, quality of service guarantees, and control policies for PEM. Validation results based on hardware-in-the-loop and in-the-field demonstrations will be presented as well.

Dr. Mads Almassalkhi

The University of Vermont

Bio: Mads Almassalkhi is an Assistant Professor in the Department of Electrical and Biomedical Engineering at the University of Vermont and co-founder of startup Packetized Energy. His research interests lie at the intersection of power systems, mathematical optimization, and control systems and focus on developing scalable algorithms that improve responsiveness and resilience of power systems. He was awarded the Outstanding Junior Faculty award by his college in 2016. Prior to joining the University of Vermont, he was lead systems engineer at Root3 Technologies, which developed SaaS for set-point optimization of central energy plants. Before that, he received his PhD from the University of Michigan in Electrical Engineering (EE): Systems in 2013 and a dual major in Electrical Engineering and Applied Mathematics at the University of Cincinnati in Ohio in 2008. When he is not working on energy challenges or teaching, he is spending his time with his amazing wife and their three children.