

# Stochastic Hybrid Systems Formalisms for Renewable Energy Systems Reliability and Performance Estimation

Sairaj Dhople  
Assistant Professor  
Department of Electrical and Computer Engineering  
University of Minnesota (Minneapolis)

This talk presents computationally inexpensive and analytically tractable stochastic models for renewable energy systems under the general framework of polynomial stochastic hybrid systems (SHS). This formalism couples stochastic differential equations that describe relevant system dynamics, e.g., output power of a wind farm, grid current injected by a photovoltaic (PV) inverter, within a hybrid systems modeling framework. Transitions between discrete modes are stochastically triggered and could be system-state dependent. The SHS framework provides nonlinear differential equations that govern the moments of the relevant states. The modeling framework is demonstrated to be computationally inexpensive (by orders of magnitude in some cases) compared to Monte Carlo methods for rare-event simulation, performance estimation, and design verification of renewable electric energy systems. Several applications pertaining to reliability and performance modeling of power electronics and power systems with a focus on PV energy conversion systems will be presented.

## **Bio:**

Sairaj Dhople is an Assistant Professor with the Power and Energy Systems Research Group at the University of Minnesota (Minneapolis). He received his B.S., M.S., and Ph.D. degrees in Electrical Engineering from the University of Illinois at Urbana-Champaign in 2007, 2009, and 2012, respectively. His research interests lie in the area of modeling, analysis, and control of power electronics circuits and power systems, with a focus on the impact of renewable integration.