

**ADCHEM 2015 Workshop:**  
**Model-based Estimation, Fault Diagnosis, and Control of**  
**Uncertain Nonlinear Systems Using Polynomial Chaos**  
Sunday, June 7, 2015 (Whistler, Canada)

**Organizers and Speakers:**

Ali Mesbah (UC Berkeley, USA)  
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**Overview:**

Uncertainties are ubiquitous in complex chemical and biological systems. System uncertainties typically arise from measurement noise, parametric uncertainties, and exogenous disturbances. Systematic consideration of uncertainties in model-based estimation and control of complex systems is a particularly challenging problem, and has been the subject of extensive research in the systems and control community. Polynomial chaos is a potentially promising tool for uncertainty characterization and propagation through nonlinear dynamical systems with probabilistic uncertainties that possess arbitrary probability distributions. Rooted in the pioneering work of Norbert Wiener in 1938, polynomial chaos provides a computationally tractable spectral framework for uncertainty propagation by replacing the implicit mappings between the uncertain variables/parameters and the system states with an expansion of orthogonal polynomials. This allows efficient computation of uncertain variables' statistics using the expansion coefficients. This workshop is intended to present the promises and challenges of the polynomial chaos framework for estimation and control of a general class of complex systems to the process systems engineering and control community.

**Outline:**

The first part of the workshop will provide an overview of the theory of polynomial chaos. In addition, a Matlab-based polynomial chaos toolbox will be introduced. The toolbox will be used in the subsequent talks to demonstrate the use of the polynomial chaos framework. In the second part, the application of the polynomial chaos framework to several model-based estimation, fault diagnosis, and control problems for uncertain, nonlinear systems will be presented. The estimation and control approaches will be illustrated using real-world applications. The outline of the workshop is as follows:

- Introduction to the generalized polynomial chaos framework
- Introduction to the polynomial chaos Matlab toolbox
- Input design for optimal experimental design and active fault diagnosis
- Stochastic MPC with chance constraints
- Dual identification and MPC

For additional details, please visit: [http://adchem2015.org/wp2015/?page\\_id=244](http://adchem2015.org/wp2015/?page_id=244)