Course Announcement

Math 656 Advanced Subjects in Numerical Analysis: Methods for Stochastic and Random Differential Equations

Instructor:	Nathan Gibson <gibsonn@math.oregonstate.edu>
Term:	Spring 2014
Space-Time:	ROG 440, MWF 9:00-9:50
CRN:	53981 (MTH659 CRN: 55189)

Background: Accurate estimates for the propagation of uncertainty through complex systems is necessary for predictive simulation, robust design, and failure analysis. This course is concerned with the numerical solution of differential equations which include uncertainty, either in system parameters, source terms, or in initial/boundary conditions.

Content: In this course we will develop basic mathematical foundations and algorithmic aspects of stochastic computations. The necessary background in polynomial approximation, numerical integration, and probability theory will be developed. While the emphasis will be on random differential equations, stochastic differential equations will be discussed. Methods covered will include Karhunen-Loeve expansion, generalized Polynomial Chaos, Stochastic Collocation, Spectral Stochastic Finite Element Method, Euler-Maruyama method for SDEs, among others. Topics will include convergence, stability, error estimates and implementation issues. As time allows, we will discuss challenges arising from high-dimensional problems, inverse problems/robust optimization and data assimilation.

Students: The course is intended for graduate students of mathematics, computer science, biology, science, and engineering. A basic knowledge of probability, linear algebra, ordinary and partial differential equations, and introductory numerical analysis techniques is assumed. The assignments will be a mixture of theoretical and computational exercises. Please contact the instructor with questions about background.

Sequence: This course is the third in a year-long sequence on Advanced Subjects in Numerical Analysis. The courses in this sequence can be taken independently.

References: There is no required text for the course, but the following are recommended:

[1] Roger G Ghanem and Pol D Spanos. *Stochastic Finite Elements: A Spectral Approach*. Courier Dover Publications, 2003.

[2] Olivier P Le Maître and Omar M Knio. *Spectral methods for uncertainty quantification: with applications to computational fluid dynamics*. Springer, 2010.

[3] Ralph C Smith. *Uncertainty Quantification: Theory, Implementation, and Applications*, volume 12. SIAM, 2013.

[4] Dongbin Xiu. *Numerical methods for stochastic computations: a spectral method approach*. Princeton University Press, 2010.

A more detailed description is available online at:

`http://www.math.oregonstate.edu/~gibsonn/Teaching/MTH656-001S14`