CEE 598UQ: Uncertainty Quantification — Spring 2020

Instructor: Hadi Meidani (meidani@illinois.edu)

Contact Information

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Course website

Our course is on piazza, accessible at https://piazza.com/illinois/spring2020/cee598uq/home. This is where announcements, HW assignments and other supplemental materials will be posted.

Textbook

There is no required textbook. The following books are recommended resources to accompany the lecture notes:

- Ghanem, R, Higdon, R, Owhadi, H. (2017). *Handbook of Uncertainty Quantification*, available online at https://www.springer.com/gp/book/9783319123844.
- Ralph Smith (2014). *Uncertainty quantification*, SIAM.
- Dongbin Xiu (2010). *Numerical methods for stochastic computation*, Princeton University Press.
- Robert, C., and Casella, G. (2013). *Monte Carlo statistical methods*. Springer Science and Business Media.
- Kolmogorov, A. N., and Fomin, S. V. (1970). *Introductory real analysis*. Courier Corporation.

Grading

Grading will be based on an absolute performance scale, although the right to curve everyone up is reserved if a too difficult exam is given. The grading will be determined by the following tentative weighting:

- Homework assignment 70%
- Project 30%
- Total 100%

Homework

Assignments turned in after the due date will be considered late. Late assignments will be accepted with a 20% penalty within 24 hours. After 24 hours, no delinquent homework will be accepted for credit. I permit and encourage intellectual collaboration on assignments. The objective of homework assignments is learning, and I recognize that working together is an excellent way of doing that. However, I expect that each student will write their own code, and their own answers to questions in their own words.

Tentative list of topics

- Goals and applications of uncertainty quantification
- Brief review of important concepts from probability theory
- Monte Carlo sampling methods
- Advanced sampling techniques, variance reduction
- Markov chain Monte Carlo (MCMC)
- Statistical inference, model calibration
- Random fields, Karhunen-Loeve expansion
- Gaussian processes
- Polynomial surrogates
- Probabilistic machine learning: least square, compressed sensing
- Sparse grid
- Surrogate-based Bayesian inference
- Model error and model validation
- Bayesian model averaging