



QMC Opening Workshop August 28-September 1, 2017

Lecture: *Bayesian Probabilistic Numerical Methods (Part I)*

Speaker: Chris Oates

Abstract:

In this work, numerical computation - such as numerical solution of a PDE - is treated as an inverse problem in its own right. The popular Bayesian approach to inversion is considered, wherein a posterior distribution is induced over the object of interest by conditioning a prior distribution on the same finite information that would be used in a classical numerical method. The main technical consideration is that the data in this context are non-random and thus the standard Bayes' theorem does not hold. General conditions will be presented under which such Bayesian probabilistic numerical methods are well-posed, and a sequential Monte-Carlo method will be shown to provide consistent estimation of the posterior. The paradigm is extended to computational "pipelines", through which a distributional quantification of numerical error can be propagated. A sufficient condition is presented for when such propagation can be endowed with a globally coherent Bayesian interpretation, based on a novel class of probabilistic graphical models designed to represent a computational work-flow. The concepts are illustrated through explicit numerical experiments involving both linear and non-linear PDE models. Full details are available in [arXiv:1702.03673](https://arxiv.org/abs/1702.03673).