

## Adwaye Rambojun- SIAM UQ16 Report

This report gives details of my attendance to the SIAM Uncertainty Quantification Conference from April 4, 2016 to April 8, 2016 at the Swisstech Convention Centre in EPFL, Lausanne, Switzerland. The duration of the STSM was 5 days.

On Monday April 4, 2016, I had a meeting with Matthieu Martin who is working on MLMC methods for optimal control problems. He gave Gianluca Detommaso (the other person attending the conference from Bath) and I an introduction of what he was working on. Both Gianluca and I also did the same. Gianluca talked about dimension independent MCMC while I talked about Bayesian Gaussian Process Latent Variable models.

The conference started on Tuesday April 5, 2016. Each day was composed of 2 plenary talks and 3 mini symposia. There were multiple mini symposia running at the same time at any given time slot that was allocated to these. One of the reasons I attended the conference was to see how machine learning is used in Uncertainty Quantification. For this reason, most of the talks that I have been attending dealt with Gaussian Processes and data driven techniques.

On Tuesday, I attended a mini symposium series, entitled "Computational Challenges in Gaussian Processes". The main idea of this series was to replace the covariance matrix with a sparse version so as to speed up Kriging. As projection to lower dimensions is one of my areas of interest, I attended a minisymposium series that dealt with that on Wednesday. Alessio Spantini from Yousef Marzouk's MIT group gave a very good talk on how to speed up MCMC by deforming densities that we can sample from into our target by using measure transport. On Thursday, I attended the mini symposium series on Probabilistic numerics and on Friday I attended another couple of talks on Gaussian Processes, which dealt with the balance between feature extraction and sensitivity.

I had a couple of discussions with people working in areas I was interested in. On Wednesday I spoke to Alireza Daneshkahi from Warwick University after his talk on deep Gaussian Processes. His conclusions were that as opposed to neural networks, Gaussian Networks had a probabilistic interpretation. On Thursday I spoke to Ahmed El Sheikh from Herriot Watt University about using classifiers in subset simulation to separate hierarchical sets. Later that day, I had a chat with Oksana Chekrebtii whose paper I worked on for my undergraduate thesis. We exchanged some ideas about her probabilistic ODE solver. In particular, I suggested pairing up her method with multilevel monte carlo and doing the analysis on the performance of her solver when dealing with hamiltonian systems. She suggested I send her some of the work I did on this over the summer.

After attending the conference, I have a better idea on how to incorporate machine learning techniques into UQ. Model dynamics are usually captured by pdes and dynamical systems. However, talks by Alireza Daneshkahi and Arethra Teckentrup (both from Warwick University) give ways of going around these dynamical systems. Rare event simulation could also use some machine learning techniques. This was highlighted by Ahmed Al Sheikh who uses Support Vector Machines to draw boundaries around sets corresponding to low probability masses.

Another area that I explored at the conference was dimensionality reduction using projections. Paul Constantine's group from the Colorado School of Mines had an interesting poster session on this on Tuesday. Their technique of "Active Subspaces" has many uses. Making it optimal in MCMC is the next step in their research and is something that I will follow closely.

The conference was well organised and the talks covered a wide range of topics. Attending it has allowed me to broaden my knowledge of computational methods being currently used in the field and to meet people working in different areas of UQ.