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Uncertainty Quantification with Gaussian Process Latent Variable Models

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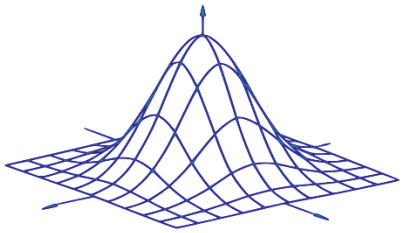
D202 Seminar room, School of Engineering, 2nd Floor

Abstract: Running complex stochastic input models can be computationally demanding. Individual simulations may take hours, or days to complete on a supercomputer. Further, to quantify the uncertainty in the response due to the stochastic input variables we must run the simulation multiple times for different inputs. To alleviate this cost it is common practice to build a surrogate model, trained on a well-selected set of stochastic input variables. However, when using surrogates such as Gaussian process regression, we are largely restricted if we want to capture correlations between a significant number of output variables, for instance at different spatial or temporal points, due to the large computational cost of current methods. Towards this end we utilized the Bayesian Gaussian process latent variable model to perform non-linear dimensionality reduction, with an automatic, probabilistic pre-image mapping. BGP-LVM allowed us to marginalize out the translation matrix and variationally integrate out the latent variables to obtain a variational lower bound for the marginal likelihood. Optimization of this lower bound is robust to over-fitting and can automatically select the dimensionality of the latent space. After obtaining a lower dimensional representation of the output we constructed our surrogate model using a co-regionalized Gaussian process from the stochastic input parameters to the hidden latent space, before using the automatic reconstruction map of the BGP-LVM to probabilistically map from the hidden space to the high dimensional output space.

More info: http://www2.warwick.ac.uk/fac/sci/wcpm/seminars



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