



Contribution ID: 126

Type: **not specified**

Computer Code Validation via Mixture Model Estimation

Monday, 11 September 2023 15:10 (30 minutes)

When computer codes are used for modeling complex physical systems, their unknown parameters are tuned by calibration techniques. A discrepancy function is added to the computer code in order to capture its discrepancy with the real physical process. This discrepancy is usually modeled by a Gaussian process. In this work, we investigate a Bayesian model selection technique to validate the computer code as a Bayesian model selection procedure between models including or not a discrepancy function. By embedding the competing models within an encompassing mixture model, we consider each observation to belong to a different mixture component. The model selection is then based on the posterior distribution of the mixture weight which identifies under which model the data are likely to have been generated. We check the sensitivity of posterior estimates to the choice of the parameter prior distributions. We illustrate that the model discrepancy can be detected when the correlation length in the Gaussian process is not too small. The proposed method is applied to a hydraulic code in an industrial context. This code being non linear in its calibration parameter, we used linear surrogate illustrating that our method can be used for more complex codes provided a reasonable linear approximation.

Keywords

Mixture estimation model, Computer code validation, Bayesian model selection, Noninformative prior

Classification

Both methodology and application

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Session Classification: INVITED SFdS on Bayesian Statistics

Track Classification: Other/special session/invited session