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Surrogate-based parameter inference in debris flow model

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This contribution concerns the problem of calibrating some unknown parameters of a debris flow model. To this end, we have experimental measurements consisting in the evolution over time of the flow thickness of the debris from a dam-break initial conditions [2]. However, we have a limited information regarding the experimental data treatment and processing. The proposed methodology consists in establishing a surrogate model of the partial differential equations solution (system of conservation laws for the depth average flow [2]) and its dependences on the parameters. The surrogate model is used in place of the original model to carry the inference problem, saving computational burden. In practice, we use a preconditioned non-intrusive pseudo-spectral Polynomial Chaos method [1] to construct the surrogates model of the experimental measurements.

The values of the parameters are then inferred through a Bayesian approach, with a particular focus on inference discrepancies that some of the important features predicted by the model exhibit. The results of the Bayesian inference suggest that utilizing directly all the available experimental data could lead to incorrect conclusions, including the over-determination of parameters. To avoid such drawbacks, we propose to base the inference on few significant features extracted from the original data. Our numerical experiments confirm the validity of this approach and show that it does not lead to significant loss of information. It is further computationally more efficient than the direct approach and can avoid the construction of an elaborate error model.

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