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Masoud Asadzadeh
University of Manitoba, masoud.asadzadeh@umanitoba.ca

Mohammad Semnani
University of Manitoba, semnanim@myumanitoba.ca

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Coupled Global Optimization and Sensitivity Analysis: Application to Model Calibration

Masoud Asadzadeh [a], **Mohammad Semnani** [a]
[a] *Department of Civil Engineering, University of Manitoba, 15 Gillson Street, Winnipeg, MB, Canada, R3T 5V6 (Masoud.asadzadeh@umanitoba.ca, semnanim@myumanitoba.ca)*

Abstract: Advanced hydrologic models have a large number of parameters that can be calibrated to improve the model performance. It is well-known that in general, the model parameter identifiability decreases as the number of model parameters increases in automatic calibration. Therefore, a model sensitivity analysis is often recommended prior to the model calibration to reduce the number of calibrated parameters and therefore increase the parameter identifiability. In this study, the Dynamically Dimensioned Search global single-objective optimization algorithm is coupled with a global sensitivity analysis algorithm by developing a feedback loop between the two algorithms to guide the optimization with a measure of parameter sensitivity that is dynamically updated based on the optimization search history. The modified optimization algorithm is applied to solve a single-objective hydrological model calibration problem that has a relatively large number of parameters with a range of computational budgets from what is deemed limited to large budgets. Results show improved automatic calibration efficiency, especially when the computational budget is limited. Moreover, results show that, a large portion of the computational budget is used to perturb the most sensitive parameters that are automatically identified by the modified optimization algorithm.

***Keywords**:* sensitivity analysis; single objective optimization; model calibration; parameter identifiability