Sensitivity analysis of an avalanche flow dynamics model using aggregated indices

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Abstract:

Avalanche flow dynamics models depend on inputs that are poorly known (e.g. friction parameters, initial conditions corresponding to the avalanche release, etc). The outputs of these models are commonly both functional and scalar and they are employed for land-use planning and the design of defense structures. Thus, it is required to assess the impact of the uncertainty of the parameters on the outputs, and this is the aim of sensitivity analysis. It is possible to apply sensitivity analysis to each output of the model separately but this leads to redundancy in the results. An alternative based, on aggregated Sobol' indices was proposed by [2] (see also [1]). We propose here to reduce functional outputs to vectorial ones and then to compute aggregated Sobol' indices. Specifically, we developed the sensitivity analysis of two functional and one scalar output of an avalanche dynamics model. First, the outputs are decomposed in basis functions using simultaneous principal components and then, the generalized Sobol' sensitivity indices are computed on the coefficients of the expansion. Application is made to a fluid avalanche model based on depth-averaged Saint-Venant equations on a typical avalanche path. The results show that the Coulombian friction coefficient is the most influential input of the model on a case study path but the influence of the other inputs is not negligible.

References

[1] F. Gamboa, A. Janon, T. Klein, and A. Lagnoux. Sensitivity analysis for multidimensional and functional outputs. *ArXiv e-prints*, November 2013.

[2] Matieyendou Lamboni, David Makowski, Simon Lehuger, Benoit Gabrielle, and Herv Monod. Multivariate global sensitivity analysis for dynamic crop models. *Field Crops Research*, 113(3):312 – 320, 2009.

Short biography – I'm a second year PhD student. I have an engineering Mathematics degree from the Escuela Politécnica Nacional (Ecuador) and a master's degree in Applied Mathematics from the University of Grenoble. My doctoral project is about the sensitivity analysis and the Bayesian calibration of avalanche models using data of high spatio-temporal resolution. This project is founded by OSUG@2020 and the CDP-Trajectories framework.