Sensitivity Analysis should go Global

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Mathematical modellers from many different disciplines and from regulatory agencies worldwide agree on the importance of a careful sensitivity analysis (SA) of model-based inference. The most popular SA practice seen in the literature is that analyzing 'one-factor-at-a-time' (OAT). This consists of investigating the effect of varying one model input at a time while keeping all the others fixed at some baseline, or nominal, value. In spite of the existing shortcomings of OAT, its widespread use among modelers raises concerns on the quality of the associated sensitivity analyses.

In this work we provide a geometric proof of the inefficiency of OAT and we propose a global approach, increasingly becoming mainstream, that characterizes how the global variation in input, due to its uncertainty, impacts on the overall uncertain of the model. The global approach is far more effective than OAT as it is based on exploring the space of the inputs over its finite (or even infinite) space of uncertainty. Within such space, alternative input assumptions are selected within some plausible range and are explored

Almost all global methods are based on the second order moment properties of the uncertain model output; a multitude of methods or techniques exist for estimating the global sensitivity indices. Prominent among them are Fourier-based techniques (FAST and RBD), smoothing techniques based on meta-modeling (such as polynomial Chaos expansions and State Dependent Regressions), and the methodology proposed by Sobol' which has undergone several improvements in the last few years.

In this work we focus on this latter method and provide the most recent detailed recipe to address the estimation of first order and total order sensitivity measures when the inputs are independent (Saltelli et al., 2010).

REFERENCES

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