

Active Learning for Global Sensitivity Analysis

Mohit Chauhan ^a, Mariel Ojeda-Tuz ^b, Ryan Catarelli ^b,
Kurtis Gurley ^b, Michael Shields ^a

^a *Johns Hopkins University, Baltimore, Maryland, USA,*

^b *University of Florida, Gainesville, Florida, USA*

This study develops a learning function to perform Global Sensitivity Analysis (GSA) for computationally expensive models. The computation of sensitivity index through Pick and Freeze method (Monte-Carlo approach) is infeasible for complex physical models and suffers greatly from the curse of dimensionality. One way to resolve this issue is to use surrogate models for the computation of sensitivity indices, such as gaussian processes (Kriging) or polynomial chaos expansions (PCE). In the literature, numerous surrogate-based learning functions are available, which try to identify an optimal surrogate training set, through adaptive selection of sample points. These learning functions (such as U-function, EIF, EIGF) are popular to achieve different tasks such as Reliability analysis, Optimization and Global fit. Here, a novel learning function is proposed, with the aim of efficient computation of sensitivity indices. The learning function minimizes the uncertainty in the Sobol Indices and generates an efficient design of experiment to identify important inputs/features with high precision. The performance of the proposed learning function is illustrated through various numerical examples, where true values of the main effect sobol indices are known. Further, results of sensitivity analysis will be presented from a large-scale experimental setup. This learning function is used to guide a physical experiment in Boundary Layer Wind Tunnel at the University of Florida. The experiment is modeled as a 10-dimensional problem and important features are identified based on the first order sobol indices.