Point estimate-based importance analysis for structural models with correlated variables.

Summary: Importance analysis is conducted to find the contributions of the inputs to the output uncertainty. In this work, a point estimate-based importance analysis algorithm is established for models involving correlated input variables, and the variance contribution by an individual correlated input variable is decomposed into correlated contribution and uncorrelated contribution. In the established algorithm, the correlated variables are orthogonalized to generate corresponding independent variables, and the performance function is reconstructed in the independence space. Then, the point estimate is employed to compute the variance-based importance measures in the independence space, by which the variance contribution of the original correlated variables, including the correlated part and uncorrelated part, can be obtained. Different point estimate methods can be employed in the proposed algorithm; thus, the algorithm is adaptable and improvable. The proposed algorithm avoids the sampling procedure, which usually consumes a heavy computational cost. Discussion of numerical and engineering examples in this work has demonstrated that the proposed algorithm provides an effective tool to deal with uncertainty analysis involving correlated inputs.

Keywords: variance; correlation; point estimate; importance measure

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