
A FAST GLOBAL SENSITIVITY ANALYSIS TECHNIQUE TO HIGHLY CORRELATED OUTPUTS

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ABSTRACT

Global Sensitivity Analysis (GSA) is crucial for addressing the uncertainty of input variables in complex systems. However, traditional methods are inefficient and difficult to interpret when dealing with high-dimensional outputs. This paper introduces a GSA method that combines Principal Component Analysis (PCA) and Polynomial Chaos Expansion (PCE). PCA is used for dimensionality reduction, decreasing the complexity of multivariate and high-dimensional outputs, while PCE accurately estimates Sobol's indices through polynomial expansion. This method not only improves computational efficiency and interpretability but also effectively addresses the sensitivity analysis of high-dimensional correlated outputs. Validated through a pile case, the PCA-PCE to calculate the Sobol's indices demonstrates significant advantages in handling complex multivariate and high-dimensional correlated outputs.

Keywords Global Sensitivity Analysis; Sobol's indice; Principal Component Analysis; Polynomial Chaos Expansion; High-dimensions; Correlated Outputs

1 Introduction and related work

2 Selected ingredients

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- 2.1 Polynomial chaos expansion**
- 2.2 Principal component-based Polynomial chaos expansion**
- 2.3 Hoeffding Sobol decomposition**

3 Computational details

4 Validation: Global sensitivity to an excavation

5 Summary and Conclusions

6 Software and data availability

References