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Paper Review: Multi-level multi-fidelity sparse polynomial chaos expansion based on Gaussian process regression

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The polynomial chaos expansion (PCE) approaches have drawn much attention in the field of simulation-based uncertainty quantification (UQ) of stochastic problem. In this paper, we present a multi-level multi-fidelity (MLMF) extension of non-intrusive sparse PCE based on recent work on recursive Gaussian process regression (GPR) methodology. The proposed method firstly builds the full PCE with varying degree of fidelity based on GPR technique using orthogonal polynomial covariance function. Then an autoregressive scheme is used to exploit the cross-correlation of these PCE models of different fidelity level, and this procedure yields a high-fidelity PCE model that encodes the information of all the lower fidelity levels. Furthermore, an iteration scheme is used to detect the important bases of PCE in each fidelity level. Two challenging cases are considered to validate the performance of the proposed method. The results show that the present method can achieve more accurate PCE compared to the Least angle regression technique.