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HIGH DIMENSIONAL UNCERTAINTY QUANTIFICATION USING THE DERIVATIVE APPROACH

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In this paper a new non-intrusive method for estimation of uncertainty in computational models is presented. The method is based on a new equation, which is derived from the ANOVA-decomposition. The method decomposes a stochastic space into sub-domains, which then are separately interpolated. This leads to a dramatic reduction of necessary samples for high dimensional spaces.

The non-intrusive interpolation technique couples the Multi-dimensional Lagrange Interpolation technique with the Derivative Equation, while samples are obtained through a new sampling strategy, the non-complete tensor product, which allows arbitrary number of samples for higher dimensions. The Monte Carlo simulation is then applied on the surrogate model to obtain full statistical properties of the considered expensive function.

The proposed method is compared to the Non-intrusive Polynomial Chaos (Point collocation approach) with Smolyak Sparse Grid sampling strategy, which is used as a surrogate model and statistical properties are obtained by the MC simulation. The comparison is made on well known analytic functions used as test problems for uncertainty quantification methods. The proposed method converges faster to low level of errors and, therefore, it is expected that it could be very useful for practical applications.