Sparse Grid Stochastic Collocations for Experimental Design:

Consider a response of interest as a function of variables in experimental matrix with distributed values . The can be approximated by generalized polynomial chaos expansion method, i.e., as a combination of polynomials of varying degree in each dimension of the input space. In stochastic collocation method, an N-D grid is constructed with the measured response to approximate the coefficients of polynomial functions. Obtaining at each collocation point may take considerable time and effort. The number of necessary experiments can be significantly reduced by employing Smolyak-like sparse grid algorithms, which use reduced combinations of polynomial orders to reduce the necessary number of input space explorations. Smolyak sparse grids are used to discover the smallest necessary quadrature set to integrate a multidimensional polynomial integral with varying orders of predetermined quadrature sets.