

A sparse grid collocation scheme for stochastic inverse problems¹

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Inverse problems for computing problem parameters based on data measurements at specific sensor locations become increasingly complicated in the presence of uncertainties in boundary conditions, material properties etc. A stochastic inverse problem is defined as computing the optimal PDF of parameters based on PDF of physical fields of interest. This stochastic inverse problem is posed as a stochastic optimization problem. A gradient based approach is employed for computing the optimal solution. The gradients are defined using perturbations to the PDF of parameters. These stochastic sensitivity fields are computed using a time-efficient sparse grid stochastic collocation scheme. Using the above-mentioned technique, the problem is reduced to computing deterministic sensitivities in specific collocation points of the support space. The computational efficiency of this scheme shows remarkable improvement over the generalized polynomial chaos approach which has been used to tackle such problems. Several numerical examples including stochastic inverse heat conduction problems and stochastic contamination source identification problems in flow through porous media will be discussed.

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