H-Matrix Based Second Moment Analysis for Rough Random Fields

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The efficient solution of operator equations with random right hand side is considered. The solution's two-point correlation can efficiently be computed by means of a sparse grid or a low-rank approximation if the two-point correlation of the right hand side is sufficiently smooth. Unfortunately, the problem becomes much more involved in case of rough data. However, the rough data and also the inverse operators can efficiently be represented or approximated by means of H-matrices. This enables us to solve the correspondent H-matrix equation in almost linear time by the use of the H-matrix arithmetic. Numerical experiments stemming from partial differential equations with random input data discretized by the finite element and the boundary element method are provided to validate and quantify the presented methods and algorithms.

References:

[1] J. Dölz, H. Harbrecht, and M. Peters. H-matrix accelerated second moment analysis for potentials with rough correlation. J. Sci. Comput., 65(1):387-410 (2015).

[2] J. Dölz, H. Harbrecht, and C. Schwab. Covariance regularity and H-matrix approximation for rough random fields. Preprint 2014-11, Mathematisches Institut, Universität Basel, Switzerland, 2014.

[3] J. Dölz, H. Harbrecht, and M. Peters. H-matrix based second moment analysis for rough random fields and finite element discretizations. Preprint 2015-35, Mathematisches Institut, Universität Basel, Switzerland, 2015.

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