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Part of PP203 Minisymposterium: Multi-level and Multi-fidelity Monte Carlo Methods for Uncertainty Quantification
Minisymposterium: Computation of Electromagnetic Fields Scattered From Objects of Uncertain Shapes Using Multilevel Monte Carlo

Abstract. Computational tools for characterizing scattering from objects of uncertain shapes are highly useful in the fields of electromagnetics, optics, and photonics, where device performance oftentimes is subject to manufacturing tolerances. Often, such computational tools use the Monte Carlo (MC) method to sample a parametric space describing geometric uncertainties. For each sample, which corresponds to a realization of the geometry, a deterministic electromagnetic solver computes the scattered fields. However, for an accurate statistical characterization the number of MC samples has to be large. In this work, to address this challenge, the continuation multilevel Monte Carlo (CMLMC) method is used together with a surface integral equation solver. The CMLMC method optimally balances statistical errors due to sampling of the parametric space, and numerical errors due to the discretization of the geometry using a hierarchy of discretizations, from coarse to fine. The number of realizations of finer discretizations can be kept low, with most samples computed on coarser discretizations to minimize computational work. Consequently, the total execution time is significantly reduced, in comparison to the standard MC scheme.

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