ISOGEOMETRIC MULTILEVEL QUADRATURE FOR FORWARD AND INVERSE RANDOM ACOUSTIC SCATTERING

JÜRGEN DÖLZ, HELMUT HARBRECHT*, CARLOS JEREZ-HANCKES, AND MICHAEL D. MULTERER

ABSTRACT

We study the numerical solution of forward and inverse acoustic scattering problems by randomly shaped obstacles in three-dimensional space using a fast isogeometric boundary element method. Within the isogeometric framework, realizations of the random scatterer can efficiently be computed by simply updating the NURBS mappings which represent the scatterer. This way, we end up with a random deformation field. In particular, we show that the knowledge of the deformation field's expectation and covariance at the surface of the scatterer are already sufficient to model the surface Karhunen-Loève expansion. Leveraging on the isogeometric framework, we utilize multilevel quadrature methods for the efficient approximation of quantities of interest, such as the scattered wave's expectation and variance. Computing the wave's Cauchy data at an artificial, fixed interface enclosing the random obstacle, we can also directly infer quantities of interest in free space. Adopting the Bayesian paradigm, we finally compute the expected shape and the variance of the scatterer from noisy measurements of the scattered wave at the artificial interface. Numerical results for the forward and inverse problem are given to demonstrate the feasibility of the proposed approach.

References

[1] J. Dölz, H. Harbrecht, C. Jerez-Hanckes, and M.D. Multerer. *Isogeometric multilevel quadrature for forward and inverse random acoustic scattering.* Comput. Methods Appl. Mech. Engrg. 388 (2022), 114242.

* Department of Mathematics and Computer Science, University of Basel, Switzerland, helmut.harbrecht@unibas.ch