Generalized Method of Moments: A novel framework for analyzing acoustic scattering from complex objects using a locally smooth surface parametrization and adaptive basis spaces

Naveen Nair, Balasubramaniam Shanker, Leo Kempel

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The analysis of scattering from complex objects using surface integral equations is a challenging problem. Its resolution has wide ranging applications- from crack propagation to diagnostic medicine. The two ingredients of any integral equation methodology is the representation of the domain and the design of approximation spaces to represent physical quantities on the domain. The order of convergence depends on both the surface and geometry representation. For instance, most surface models are restricted to piecewise at or second order tessellations. Similarly, the most commonly known basis spaces for acoustics are piecewise constant functions. What is desirable is a framework that permits adaptivity (of size and order) in both geometry and function representations. Unlike volumetric, di?erential equation solvers, such as the ?nite element method, developing an hpadaptive framework for surface integral equations is very di?cult. This papers proposes a resolution to this problem by developing a novel framework that relies on reconstruction of the surface using locally smooth parameterizations, and de?ning partition of unity functions and higher order basis spaces on overlapping domains. This permits easy re?nement of both the geometry and function representation. This capabilities of the proposed framework are shown via a number of numerical examples

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