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A PARTITION OF UNITY BASED ISOGEOMETRIC FEM FOR ACOUSTIC SCATTERING IN 2D

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The Finite Element Method (FEM) has long established itself as an attractive choice for numerical modelling of wave scattering problems. The key feature of FEM is that it is a general numerical method that can be used for modelling complex geometries and heterogeneous materials.

The NURBS based or Isogeometric FEM (IGAFEM) has been shown to be more accurate than FEM for a given number of dofs and is better suited for geometry where its CAD description is readily available [1]. Although IGAFEM is more accurate and less susceptible to pollution in a given frequency range compared to FEM; both these methods become computationally expensive for high frequency wave problems. To approximate the oscillatory solution of Helmholtz PDE accurately, sufficient number of degrees of freedom (nDOF) are required. In general, for the element based methods nDOF $\propto k^d$. This makes the numerical modelling of high frequency problems a computationally intensive task.

In this paper, we present a Partition of Unity based Isogeometric FEM (PUIGAFEM) for solving acoustic scattering problems in 2D. We extend the concept of Partition of Unity FEM (PUFEM) [2] to IGAFEM by using the plane wave enriched NURBS basis functions. We note the significant improvement in the accuracy when using PUIGAFEM over IGAFEM for the same number of DOFs (or even less) per wavelength. We establish both h and $Q-$convergence of the method through canonical wave problems. In addition, we demonstrate that PUIGAFEM exhibits faster convergence rates when compared to IGAFEM.

References

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