An Isogeometric Boundary Element Method with Compatible B-splines for Efficient Radar Cross Section Computations

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ABSTRACT

We outline a new isogeometric boundary element method for performing electromagnetic scattering simulations and determining radar cross section (RCS) profiles directly from CAD models. We therefore demonstrate a fully integrated design and analysis approach for efficient electromagnetic design. Our approach adopts NURBS to represent the surface geometry and constructs compatible B-spline discretizations from the given NURBS parameterizations that provide the necessary div-conforming and curl-conforming approximations for the electric field and magnetic field integral equations respectively. The approach is based on previous work which illustrates the construction of compatible B-splines for approximations in electromagnetic formulations [1] and fluid-flow [2]. We adopt a Galerkin formulation that is often referred to as the 'method of moments' within the electromagnetic engineering community.

After outlining the discretization of the relevant integral equations which govern electromagnetic scattering through compatible B-splines, we validate our approach through the classical Mie scattering problem which exhibits closed-form expressions for surface currents and RCS values. We illustrate the ability of our approach to generate high order B-spline approximations that lead to superior accuracies while retaining the exact geometry at all levels of refinement. Furthermore, we apply our approach to the well-known NASA almond problem [3] and compare against published numerical and experimental RCS results. Finally, we demonstrate the ability of our method to perform electromagnetic scattering directly on CAD geometries whereby RCS profiles can be generated efficiently for prototype electromagnetic engineering design.

REFERENCES

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