A coupled isogeometric finite element and boundary element method with subdivision surfaces for structural-acoustic analysis of shell structures

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ABSTRACT

We introduce a coupled finite and boundary element formulation for acoustic scattering analysis over thin shell structures. A triangular Loop subdivision surface discretisation is used for both geometry and analysis fields. The Kirchhoff-Love shell equation is discretised with the finite element method and the Helmholtz equation for the acoustic field with the boundary element method. The use of the boundary element formulation allows the elegant handling of infinite domains and precludes the need for volumetric meshing. In the present work the subdivision control meshes for the shell displacements and the acoustic pressures have the same resolution. The corresponding smooth subdivision basis functions have the C^1 continuity property required for the Kirchhoff-Love formulation and are highly efficient for the acoustic field computations. We validate the proposed isogeometric formulation through a closed-form solution of acoustic scattering over a thin shell sphere. Furthermore, we demonstrate the ability of the proposed approach to handle complex geometries with arbitrary topology that provides an integrated isogeometric design and analysis workflow for coupled structural-acoustic analysis of shells.