IGA-Energetic BEM for the numerical solution of 2D wave scattering problems in the space-time domain

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The Energetic Boundary Element Method (BEM) was proposed in [1] for the numerical solution of 2D exterior wave propagation problems. The hyperbolic differential model is transformed, using the fundamental solution of the wave operator, into a Boundary Integral Equation (BIE), which is then written into an energy-dependent weak form and discretized by a Galerkin-type approach. Compared to other space-time discretizations of the wave equation [4], the energetic weak form offers desirable accuracy and stability properties [1]. Taking into account the model problem of 2D soft scattering of acoustic waves by open arcs represented by B-spline (or NURBS) curves, in this talk we discuss some recent advances in the coupling of Energetic BEM with the powerful Isogeometric Analysis (IGA) approach for what concerns discretization in space variables. Indeed, IGA, proposed by T. J. R. Hughes and collaborators [5] in the context of the FEM to “bridge the gap” between design and analysis using B-splines and NURBS as shape functions, naturally fits into BEMs, allowing an exact representation of curvilinear boundaries.

In this contribution, based on [2], numerical issues for an efficient integration of the singular kernel related to the fundamental solution of the wave operator and dependent on the propagation wavefront, will be described, highlighting the new challenges posed by the presence of curvilinear boundaries. Extensive numerical experiments will show, from a numerical point of view, convergence and accuracy of the proposed method as well as the superiority of IGA-Energetic BEM compared to the standard version of the method, based on lagrangian shape functions. Simulations on long time intervals allow to observe the consistency of the proposed method with the stationary IGA-BEM [3].

References

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