Time-domain isogeometric boundary element method based on the convolution quadrature method for scalar wave propagation

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Abstract

This paper presents a time-domain isogeometric boundary element method based on the convolution quadrature method (CQM) for scalar wave propagation. The concept of isogeometric analysis, first proposed by Hughes et al, for approximating the unknown fields in a numerical discretization with the parametric functions called Non-Uniform Rational B-spline (NURBS) that are used to describe CAD geometry, has received attention in recent years.

Application of the isogeometric analysis to the Finite Element Method (FEM) has been done by several researchers [Hughes et al. (2009); Bui et al. (2016)]. The main advantage of the isogeometric FEM is not necessary to generate FEM geometry mesh. Therefore, the isogeometric FEM can produce high precision solutions due to the direct use of CAD geometry of the analysis model. However, FEM based-numerical methods cannot deal with wave propagation problems in infinite domains without any modifications such as PML and other non-reflecting boundaries [Givoli. (2004)]. Therefore, in this research, time-domain isogeometric boundary element method based on the convolution quadrature method (CQ-IGBEM) is developed for wave propagation problems in infinite domains. In general, the boundary element method is known as a suitable numerical approach, and is able to treat full and half-spaces without difficulties.

In the conference, the formulation of our proposed CQ-IGBEM for scalar wave propagation is presented. As numerical examples, the problems of scalar wave scattering by arbitrary objects are solved to validate the proposed method.

Keywords: Time-domain boundary element method, Isogeometric analysis, Wave Propagation, Convolution Quadrature Method (CQM)

References

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