Some recent advances in space-time boundary element method for wave propagation problems

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Wave propagation phenomena are of great importance in nature, since they occur in sound emissions, earthquakes, water waves, telecommunications and radar, electromagnetic and gravitational waves, to cite few examples. Since their understanding represents a fundamental tool for the knowledge of the world around us, the study of waves has been a long-standing scientific endeavour and remains an active and dynamic research field, embracing various areas of physics and engineering. Mathematically, wave propagation phenomena are described by initial-boundary value problems, whose basic ingredient is a partial differential equation of the hyperbolic type, which allows to investigate transient problems following their evolution. The differential models can often be converted into space-time integral equations involving exclusively the boundary of the physical domain, reducing the dimensionality by one. The space-time Boundary Element Method (BEM) is nowadays an established tool to deal with the discretization of such integral models. Some recent theoretical and applicative advances on space-time BEM will be presented and discussed, such as the study of *a-posteriori* error estimates to derive efficient space-time adaptive algorithms for the numerical solution of the acoustic wave equation [1] and the modeling and approximation of frictional contact problems in elastodynamics [2].

References

[1] A. Aimi et al., *A residual a posteriori error estimate for the wave equation single layer operator*, in preparation (2025)

[2] A. Aimi et al., *Space–time boundary elements for frictional contact in elastodynamics*, CMAME, **427** (2024) 117066