

Energetic BEM for the numerical solution of 2D damped waves propagation exterior problems

A. Aimi, M. Diligenti, C. Guardasoni

Department of Mathematical, Physical and Computer Sciences
University of Parma, Italy

The analysis of damping phenomena, that occur in many physics and engineering problems, reformulated in terms of boundary integral equations (BIEs) and solved via the boundary element method (BEM), is a novelty.

In this context, we develop here an extension of the so-called energetic BEM, recently proposed in literature [1], for the numerical solution of damped waves propagation problems exterior to open arcs Γ in the plane. The analysis of the soft and hard scattering of 2D damped waves is carried out directly in space-time domain, thus avoiding the use of the Laplace transform and of its inversion. Both viscous and material damping coefficients will be taken into account.

The presented numerical results confirm accuracy and stability of the proposed technique, already proved for the numerical treatment of undamped wave propagation problems in several dimensions [2-3] and for the 1D damped case [4-5]. In particular we will show that, when boundary datum becomes independent of time, transient BIE solution on Γ tends to corresponding static solution of BIE suitably related to Laplace or Helmholtz boundary value problems, equipped with the same constant boundary datum.

References

- [1] Aimi, A. and Diligenti, M., *A new space-time energetic formulation for wave propagation analysis in layered media by BEMs*, *Int. J. Numer. Meth. Engng.* **75**, 1102–1132 (2008).
- [2] Aimi, A., Diligenti M. and Panizzi S., *Energetic Galerkin BEM for wave propagation Neumann exterior problems*, *Computer Model. Engrg. Sciences* **1**(1), 1–33 (2009).
- [3] Aimi, A., Diligenti, M., Frangi, A. and Guardasoni, C., *Neumann exterior wave propagation problems: Computational aspects of 3D energetic Galerkin BEM*, *Comput. Mech.* **51**(4), 475–493 (2013).
- [4] Aimi, A. and Panizzi, S., *BEM-FEM coupling for the 1D Klein-Gordon equation*, *Numer. Methods Partial Differential Equations* **30**(6), 2042–2082 (2014).
- [5] Aimi, A., Diligenti, M. and Guardasoni, C., *Energetic BEM-FEM coupling for the numerical solution of the damped wave equation*, *Adv. Comput. Math.* in press (2017).