ENERGETIC BEM FOR THE NUMERICAL SOLUTION OF ELASTODYNAMICS CONTACT PROBLEMS

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We investigate the numerical solution of unilateral contact problems, which consider the elastodynamic stresses of a body in contact with a rigid obstacle. Such problems arise in numerous mechanical applications, from fracture dynamics and crash tests to rolling car tires. Mathematically, the nonlinear boundary condition corresponding to the contact interaction translates into a variational inequality for the linear elastodynamic equations. In spite of a wide computational literature on the topic, a rigorous theoretical analysis is difficult and results about the existence of solutions are only known for simplified model problems. Nevertheless, the importance of this study for practical purposes, above all in the time-domain framework, is clear and treatment by BEMs represents a natural choice [2], given that the contact is confined to the boundary while the interior dynamics is linear. For this reason, we propose the Energetic BEM (see e.g. [1]), that provides an efficient and stable numerical strategy for linear elastodynamics, here adapted for the solution of contact problems. This translates in the assembly of E-BEM matrices, that allow an accurate discretization of the involved Poincaré-Steklov operator, then followed by an Uzawa method, employed as an iterative solver for the nonlinear problem. Stability, convergence and implementation aspects of the E-BEM are discussed and numerical results are presented for a range of 2D geometries, with unilateral contact conditions imposed on part of the boundary (without friction).

References

[1] A. Aimi, G. Di Credico, M. Diligenti, C. Guardasoni, *Highly accurate quadrature schemes for singular integrals in energetic BEM applied to elastodynamics*, JCAM, 410 (2022), 114186.

[2] H. Gimperlein, F. Meyer, C. Ozdemir, E. P. Stephan, *Time domain boundary elements for dynamic contact problems*, CMAME, 333 (2018), pp. 147–175.