

hp -adaptive BEM for frictional contact problems in linear elasticity

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Abstract

A mixed formulation for a Tresca frictional contact problem in linear elasticity is considered in the context of boundary integral equations, which is later extended to Coulomb friction. The discrete Lagrange multiplier, an approximation of the surface traction on the contact boundary part, is a linear combination of biorthogonal basis functions. In case of curved elements, these are the solutions of local problems. In particular, the biorthogonality allows to rewrite the variational inequality constraints as a simple set of complementarity problems. Thus, enabling an efficient application of a semi-smooth Newton solver for the discrete mixed problem, converging locally super-linearly in the frictional case and quadratically in the frictionless case. Typically, the solution of frictional contact problems is of reduced regularity at the interface between contact to non-contact and from stick to slip. To identify the a priori unknown locations of these interfaces two a posteriori error estimations are introduced. In a first step the error is split into specific error contributions resulting from the contact and friction conditions and from the discretization error of a variational equation. For the latter a residual and a bubble error estimation are considered explicitly. The numerical experiments show the applicability of the derived error estimations, in particular in the Coulomb friction case, and the superiority of hp -adaptivity compared to low order uniform and adaptive approaches.

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