An Energetic Formulation of a General Interface Model

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ABSTRACT

An energetic formulation of a general interface model between linear viscoelastic bodies is presented. This interface model, with possibly several dissipation mechanisms, can cover cohesive frictional interfaces with plastic slip and interface temperature. The numerical scheme is based on a semi-implicit fractional-step time discretization procedure, sometimes referred to as staggered scheme, which leads to separately convex minimization problems in each fractional-step. Although the Finite Element Method (FEM) can be applied for spatial discretization in the present interface model, the Symmetric Galerkin Boundary Element Method (SGBEM) is implemented in this work. A suitable multi-domain SGBEM scheme is very advantageous in the case of linear viscoelastic bodies, as only the outer boundaries and interfaces need to be discretized, which eventually leads to a significant reduction of the number of unknowns in optimization. It is worth stressing that in the present computational procedure, suitable convex minimization procedures are used in each fractional step, instead of solving nonlinear systems of equilibrium equations. This approach leads to a robust, convergent and stable numerical scheme.

A couple of numerical examples show the versatility, robustness and accuracy of the present formulation and computational implementation. First, problems with a cohesive interface with Coulomb friction and/or kinematic hardening plastic slip are studied. Then, a temperature dependent frictional contact problem is solved considering the rate-and-state model of friction used in geophysical applications.

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