A Dual-Dual Formulation for the Coupling of Mixed-FEM and BEM in Hyperelasticity

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Abstract

We combine a dual-mixed finite element method with the boundary integral equation method, to study the solvability and Galerkin approximations of a linear-nonlinear transmission problem arising in plane elastostatics. Our approach is based on the introduction of the strain tensor as an auxiliary unknown in the finite element domain, and it leads to what we call a dual-dual mixed formulation since the corresponding operator equation becomes of a twofold saddle-point structure. We derive existence and uniqueness of solution for the continuous and discrete formulations and provide the associated error analysis. In particular, we extend the finite element space for plane elasticity given by the PEERS element and define an explicit finite element/boundary element subspace satisfying all the required compatibility conditions. Most of our analysis makes use of an extension of the classical Babuska--Brezzi theory to a class of nonlinear saddle-point problems.