

Edge-based Stabilized Tetrahedral Element for Nearly Incompressible Hyperelasticity

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In this paper, we discuss finite element procedures for large deformation problems of nearly incompressible hyperelasticity. To overcome volumetric locking phenomena in incompressible or nearly incompressible materials, the u-p formulation, in which displacement and pressure fields are taken as unknown variables, is employed. In the finite element discretization based on the u-p formulation, stable mixed elements satisfying the inf-sup condition or pressure stabilized method should be employed. In this work, we employ a stabilized procedure proposed by Hughes et al. In this approach, a linear tetrahedral element is employed for the displacement field and piecewise constant pressure is assumed for each element. To stabilize the pressure field, an edge-based technique that penalizes the jumps over the element edges of the piecewise constant pressures is introduced. Further, we discuss the extension of the u-p formulation to problems of nearly incompressible materials involving nonlinear volumetric energy.

Keywords: Incompressible hyperelasticity, nearly incompressible, Tetrahedral element, Edge-based stabilized method.