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REMESHING STRATEGIES FOR LARGE DEFORMATION PROBLEMS WITH CONTACT AND INCOMPRESSIBLE MATERIALS

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Under the context of finite element analysis, a dilemma emerges when both material incompressibility and remeshing are being tackled in the same problem. When one uses first order triangular or tetrahedral elements due to the ease of local mesh refinement, the problem is subject to mesh locking if nearly incompressible materials are considered. Traditional approaches to eliminate mesh locking, however, will again cost more computational resources due to the introduction of new degrees of freedom. In this project, we are trying to solve this issue by using nodally integrated triangular and tetrahedral elements [1], which eliminate the locking without introducing additional degrees of freedom. A residual-based explicit error indicator based on the mortar finite element contact method is utilized as the driver for adaptive mesh refinement.

Another important issue associated with adaptive re-meshing is the transfer of contact variables. A naive component by component interpolation of the tangential part of the contact traction or the total contact traction can result in a traction field in the new mesh violating friction laws. Having observed that the normal component of the contact traction is a scalar (a Lagrange multiplier) and that the tangential traction lives in the tangent space of the contact surface, we developed an algorithm to carry out parallel transport [2] of the tangential traction and interpolation of both the tangential and normal traction in a manner consistent with the mortar contact method. It can be shown that parallel transport followed by a partition of unity interpolation results in an interpolated traction field that satisfies a wide class of friction laws.

The results obtained so far indicate that the combination of above stated strategies is able to adaptively refine the region with contact traction singularities, hence accurately depicting the contact traction field of interest.

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