A LARGE DEFORMATION 3D MORTAR CONTACT METHOD

Michael Puso[a] and Tod Laursen[b]

[a]Lawrence Livermore National Laboratory
8000 East Ave. Livermore, California
e-mail: puso@llnl.gov

[b]Department of Civil and Environmental Engineering
Duke University, Durham N.C. 27708
e-mail: laursen@duke.edu

Contact modeling is still one of the most difficult aspects of nonlinear implicit structural analysis. Most 3D contact algorithms employed today use node-on-segment approaches for contacting dissimilar meshes. Two pass node on contact approaches have the well know deficiency of locking due to over constraint. In this work, we develop and demonstrate a segment-to-segment contact approach based on the mortar method. By eliminating the over-constraint, this method appears to be much more robust than the node on segment approach. Furthermore, node-on-segment approaches suffer when individual nodes slide out of contact, particularly at contact surface boundaries. This causes jumps in the contact forces due to the discrete nature of the constraint enforcement and difficulties in convergence for implicit solution techniques. These jumps in forces are avoided in the segment-to-segment approach, since penetration is measured by the occluded volume which varies smoothly with perturbations.

Up to now, all mortar schemes were developed for small deformation/sliding and have mainly been applied on flat surfaces. Here we will present the integration scheme and the linearization approach used for handling the contact surface integrals in the event of large sliding. The schemes are designed to conserve linear and angular momentum and can be applied to arbitrarily curved 3D surfaces. Although expensive, our numerical examples demonstrate that the approach is far more robust than even smoothed node on segment contact techniques. That is, problems previously not solvable with node on segment can now be solved with our segment-to-segment contact.