EXPLICIT TRANSIENT DYNAMICS ENFORCEMENT OF FRICTIONAL SLIDING CONTACT IN ACME[1] [2]

K.H. Brown[a], **M.W. Heinstein**[b], **R.E. Jones**[c], and **T.E. Voth**[a]

[a]Computational Physics R&D
Sandia National Laboratories
M/S 0819, P.O. Box 5800
Albuquerque, New Mexico 87185-0819
khbrown@sandia.gov, tevoth@sandia.gov

[b]Computational Solid Mechanics and Structural Dynamics
mwheins@sandia.gov

[c]Science-Based Materials Modeling
rjones@sandia.gov

Contact algorithms are now a well established part of large deformation transient dynamics simulations. They traditionally take the form of a global search strategy in which discrete constraints are defined involving nodes and faces on the surface followed by an enforcement step where these normal and tangential (frictional) constraints are satisfied to some degree [1,2]. Accurate enforcement of the frictional contact constraints, however, are seen to be sensitive to how accurately normal contact constraints are satisfied - leaving the solution suspect in some instances. It is this issue that is addressed in this talk.

Expectations for transient dynamic simulations are at a point where explicit time integrators are commonly used to achieve fast turnaround time. Calculations done every time step must therefore be fast and stable. At odds with this approach is the fact that contact constraints are implicit in nature - which we show introduces coupling to the discretized equations of motion. Contact enforcement algorithms typically rely on a strategy to avoid the potentially costly solution of the coupled set of equations at every time step. To this end, assumptions are made for the kinematic partitioning of the contact velocity mismatch allowing a fast and reasonable solution. There are many situations where underlying assumptions in this enforcement strategy are not realistic. In these situations it is seen that a more robust enforcement strategy is required. This talk discusses an implementation of iterative solution of frictional contact constraints, where the degrees of freedom must satisfy normal and frictional constraints simultaneously.

The plan of this talk is as follows. First, a summary of the nonlinear solid mechanics problem with contact constraint equations is given. This is followed by a discussion of the implementation of the contact problem in an explicit transient dynamic setting. The options for enforcing contact constraints are considered including an iterative solution strategy. Finally, results for example problems are shown which demonstrate the accuracy of the iterative techniques developed here.

References

[1] B.J. Benson, and J.O. Halquist, "A Single Surface Contact Algorithm for the Post-Buckling Analysis of Structures," *Computer Methods in Applied Mechanics and Engineering*, v. 78, p. 141-163, 1990.
[2] M.W. Heinstein, S.W. Attaway, J.W. Swegle, and F.J. Mello, *A General Purpose Contact Detection Algorithm for Nonlinear Structural Analysis Codes*, SAND92-2141, Sandia National Laboratories, 1992.

[1]A library of **A**lgorithms for **C**ontact in a **M**ulti-Physics **E**nvironment

[2]Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy under Contract DE-AC04-94AL85000.