A NEW STABILIZED NODAL INTEGRATION APPROACH

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Nodal integration of the Galerkin weak form of the equations of motion is often desirable due to its efficiency and applicability in large deformation problems. For example, it can be applied in situations were meshless interpolation functions, such as MLS, are used or linear tetrahedral shape functions are used. Different approaches have been developed such as the stabilized conforming nodal integration (SCNI) from Chen et. al. [1] and a least squares stabilization approach from Beissel and Belytschko [2]. The latter approach was applied in an EFG formulation and required at least quadratic shape functions for optimal convergence. Recently we have found that the SCNI method applied to natural element shape functions (NEM) produces spurious low energy (not zero energy) modes in some problems and these modes did not appear to vanish with refinement in eigenvalue analysis. In this work, a modification to the SCNI method is made such that stability is guaranteed. The new approach can be applied in conjunction with meshless or linear tetrahedral shape functions. For the latter, the proposed nodal integration technique is demonstrated both *analytically and numerically* to be stable and optimally convergent. In addition, an upper bound on the time step (based on the CFL condition) can be found analytically for an arbitrary 3D discretization. The method performs well in situations were both bending and nearly incompressible material are prominent. Examples using the proposed approach for meshless and linear tetrahedral discretizations are provided.

References

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