ABSTRACT

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The node-to-segment formulation is widely used for solving problems involving contact between multiple solid bodies. An essential aspect of this formulation is to ensure that the contacting node can transition from one segment to the next. However, node-to-segment formulations are prone to numerical issues such as problems with convergence and may even exhibit divergence due to sudden changes in the contact force during such transitions. Most approaches in the literature utilize *ad hoc* techniques to resolve such issues, primarily by defining different special cases for different situations. In this study, a penalty-based formulation is used, in conjunction with a smoothed contact constraint function, to overcome the numerical issues associated with such transitions. Further, hard contact between multiple segments can lead to ill-conditioned system of equations and to avoid this, a softening parameter is used to regularize the contact constraint. The proposed approach eliminates the need to distinguish between different special cases and enables the use of a single formulation to solve different types non-smooth node-to-segment contact problems. In particular, problems involving contact between components of reticulated structures, modeled as a network of planar truss elements, are studied. These include contact between elements of a braced truss and the indentation and sliding of a cellular material with a lattice micro-structure. The performance of this approach, in terms of the errors in contact enforcement, restoring forces, and the computational effort required, shows that it works well for different types of non-smooth contact problems.