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A Lagrangian Hamiltonian Computational Method for Hyper-Elastic Structural Dynamics

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Abstract : Performance of a Hamiltonian based particle method in simulation of nonlinear structural dynamics is subjected to investigation in terms of stability and accuracy. The governing equation of motion is derived based on Hamilton's principle of least action, while the deformation gradient is obtained according to Weighted Least Square method. The hyper-elasticity models of Saint Venant-Kirchhoff and a compressible version similar to Mooney- Rivlin are engaged for the calculation of second Piola-Kirchhoff stress tensor, respectively. Stability along with accuracy of numerical model is verified by reproducing critical stress fields in static and dynamic responses. As the results, although performance of Hamiltonian based model is evaluated as being acceptable in dealing with intense extensional stress fields, however kinds of instabilities reveal in the case of violent collision which can be most likely attributed to zero energy singular modes.

Keywords : Hamilton's principle of least action, particle-based method, hyper-elasticity, analysis of stability
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