APCOM & ISCM
11-14th December, 2013, Singapore

Strong Form Collocation Method for Hyperelasticity

+Thanakorn Siriaksorn and *Sheng-Wei Chi

Department of Civil and Materials Engineering, University of Illinois at Chicago, USA.

+Presenting author: tsiria3@uic.edu

*Corresponding author: swchi@uic.edu

This work presents a strong form collocation method for hyperelasticity. In the method the Lagrangian equations of motion are first linearized and then solved by the Newton-Raphson method. The solution of linearized equations of motion is obtained by using meshfree approximations, such as Radial Basis Functions (RBFs) and Reproducing Kernel (RK) functions, in conjunction with the strong form collocation method. More collocation points than source points are typically required for optimal solutions, leading to an overdetermined system of collocation equations. The key to an optimal solution when solving the overdetermined system by a least-squares method is to balance the errors between collocation equations associated with the domain, Neumann boundary, and Dirichlet boundary equations. To achieve this goal, a weighted collocation method is introduced and proper weights associated with domain and boundary collocation equations are derived. The results show that the RBF with collocation method yields an exponential convergence rate in the L_2 norm whereas the RK with collocation method yields an algebraic convergence rate, and that the Newton iteration method achieves a quadratic convergence rate. The combined errors due to the approximation, collocation, and Newton iterations are also studied. Numerical examples show that the weighted strong form collocation method offers more accurate solutions with less degrees of freedom, compared to the solutions obtained from the finite element method.

Keywords: collocation method, radial basis function, reproducing kernel collocation, hyperelasticity, meshfree method