Pseudo-Elastic Analysis of Material Nonlinear Problems using Isogeometric Collocation Method

S.S. Durga Rao[*] and Raju Sethuraman[†]

[*] Department of Mechanical Engineering, Indian Institute of Technology Madras, India.
e-mail: me14d208@smail.iitm.ac.in, web page: http://www.iitm.ac.in.

[†] Department of Mechanical Engineering, Indian Institute of Technology Madras, India.
e-mail: sethu@iitm.ac.in, web page: http://www.iitm.ac.in.

ABSTRACT

The search for an efficient quadrature rule in Isogeometric Analysis leads to the formulation of Isogeometric Collocation Method [1], which can be thought of as a one point quadrature rule. Collocation method requires less number of evaluation points for calculating the stiffness matrix than the traditional Galerkin method. In literature [2], the performance of the collocation method is compared with the Galerkin method and the collocation method is found to have superior computational performance on the basis of accuracy vs computational cost, especially when higher order polynomials are used. The reduced computational cost of the collocation method, made the method ideal for solving non-linear problems, where a number of iterations are to be performed in order to get the converged results. Pseudo Elastic Analysis based on the Hencky's total deformation theory of plasticity is presented in [3] to solve the material non-linear problems using elastic Finite Element Analysis which makes the methodology simpler and easier to implement. This method is based on defining effective material properties which are obtained in an iterative manner and it can be easily incorporated into the existing elastic finite element codes for solving material non-linear problems subjected to proportional loadings.

In the present study, Isogeometric Collocation Method is used to solve material non-linear problems based on Pseudo Elastic Analysis. Various type of hardening rules viz: perfectly plastic, bilinear hardening and Ramberg-Osgood models are considered and the Pseudo Elastic Analysis is performed for various geometries to illustrate the effectiveness of the Isogeometric Collocation Method for material non-linear problems. The obtained results are compared with the non-linear Finite Element Analysis solutions and the results are found to be in good agreement in all the cases considered.

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