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How to improve efficiency and robustness of the Newton method in geometrically non-linear structural problem discretized via displacement-based finite elements

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Abstract

In this paper we show how to significantly improve the robustness and the efficiency of the Newton method in geometrically non-linear structural problems discretized via displacement-based finite elements. The strategy is based on the relaxation of the constitutive equations at each integration point. This leads to an improved iterative scheme which requires a very low number of iterations to converge and can withstand very large steps in step-by-step analyses. The computational cost of each iteration is the same as the original Newton method. The impressive performances of the proposal are shown by many numerical tests. In geometrically non-linear analysis, the proposed strategy, called MIP Newton, seems worthy to replace the standard Newton method in any finite element code based on displacement formulations. Its implementation in existing codes is very easy.

Keywords: Geometric non-linearities, finite deformation, path-following, displacement FE, integration points, MIP Newton.

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