An adaptive strategy for model order reduction in small strain elasto-plasticity.

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ABSTRACT

Reduced order methods constitute a way to save processing time during simulations. In the last years, approaches were made to deal with plasticity using model order reduction, e.g. in [3] the model order reduction is only applied for sub-domains with “approximately” elastic behaviour. A different approach is given in [4], where a hyper-reduction prediction of the model is performed by introducing virtual inclusion. In [5], a reduced integration domain (RID) is introduced by selecting few elements of the mesh of the detailed model and considering the related balance equations, wherein the computed internal variables are extrapolated over the full domain using related proper orthogonal decomposition (POD) vectors. Moreover, in [6], a hyperelastic material law is utilized to mimick plasticity and classical reduced order methods in combination are applied.

In the presented contribution, an adaptive strategy for reduced order methods for elasto-plastic material model is presented, which is developed based on the strategy described in [1] and [2] for dynamical problems. Herein, the usage of a projection and its enrichment in different stages of the simulation procedure are the main objective and outlined in detail. The adaptive strategy is generally decomposed into two parts: an iterative and an incremental part (see [1] and [2]). In the iterative part, the initial projection matrix, which is here obtained by a POD, is enriched by snapshots from the full solution in case of divergence. Then the iteration is proceeded using a new reduced system of equations. However, in the incremental part, the iterated solution is treated as a new snapshot in order to obtain an enhanced projection for the next load step while declining the enrichment from the previous iterative process. The considered variable which is accumulated as snapshots in this reduced order method can be of several kinds. Possible candidates are displacement, plastic strains or stresses. The main aim is to show the performance of the presented adaptive strategy. Numerical examples are shown, in which the aim is to analyse the applicability of the adaptive strategy to elasto-plasticity.

REFERENCES


