„Time-FE Methods for Finite Elasto-Plasto-Dynamics - Views on Consistency“

On the one hand, computational modelling of materials and structures often demands the incorporation of inelastic and dynamic effects. On the other hand, the performance of classical time integration schemes for structural dynamics is strongly restricted dealing with highly nonlinear systems. Energy and momentum conserving time integrators for nonlinear elastodynamics are nowadays well-established in the computational dynamics community. In this context, one-step implicit integration algorithms relying on Finite Elements in space and time were developed. Thereby, conservation of energy and angular momentum have been shown to be closely related to quadrature formulas required for numerical integration in time. Furthermore, specific algorithmic energy conserving schemes for hyperelastic materials can be based on the introduction of a so-called enhanced stress tensor for time shape functions of arbitrary order. However, most of the proposed approaches are restricted to conservative dynamical systems. Nevertheless, the consideration of plastic deformations in a dynamical framework involving dissipation effects is of cardinal importance for various applications in engineering. In this contribution, we follow the concept which has been originally proposed for hyperelasticity and pick-up the general framework of Galerkin methods in space and time, developing integrators for geometrically nonlinear elasto-plastod-ynamics with pre-defined conservation properties. The performance of the resulting Galerkin-based schemes will be demonstrated by means of several numerical examples.

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