Space-Time Discretization in Computational Inelasticity

Stefan Hartmann[1]

Frequently, the inelastic material behavior is modeled using ordinary differential equations of first order (ODE). If the balance equations of thermo-mechanics (balance of linear momentum, balance of energy), which represent – in the context of the method of vertical lines – algebraic equations or ODEs itself, are coupled with these evolution equations, a system of differential-algebraic equations (DAEs) is obtained. In this lecture we start with some historical remarks of this procedure. First, diagonally-implicit Runge-Kutta methods are applied offering three aspects, classical approaches in finite elements as particular sub-problems, high-order integration in time, and time-adaptivity using embedded schemes. Second, other time-integration schemes such as Rosenbrock-type methods or half-explicit Runge-Kutta schemes are applied, where advantages and disadvantages are investigated. Some additional applications are discussed such as the combination to high-order finite elements, thermo-mechanical coupling, as well as some drawbacks with order-reduction for particular problems.

[1] Institute of Applied Mechanics, Clausthal University of Technology, Adolph-Roemer-Str. 2a, 38678 Clausthal-Zellerfeld, Germany,
stefan.hartmann@tu-clausthal.de