DAE's in Elastoplasticity

Bernd Simeon
simeon@iwrmm.math.uni-karlsruhe.de
University of Karlsruhe, Dept. of Mathematics, Germany

The constitutive equations of elastoplasticity play a key role in the simulation of deformation and failure of continuum bodies. The equations can be understood as a set of differential-algebraic equations (DAEs) with discontinuities. More specifically, due to the yield condition, the differential equations for the evolution of hardening variables and plastic strain are unilaterally constrained by some nonlinear equations. Discontinuities arise at the transition from the elastic to the plastic regime and vice versa. Additionally, this DAE of index 2 features a contractivity property which reflects the postulate of maximum plastic dissipation.

The talk presents the problem class and discusses the application of implicit Runge-Kutta methods in combination with the return mapping scheme of computational plasticity. It is shown that algebraically stable Runge-Kutta methods preserve the contractivity of the elastoplastic flow.