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Assesment of some integration methods for an evolution equation based high-cycle fatigue model

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Ottosen, Stenström and Ristinmaa proposed in 2008 [3] a concept for a macroscopic high-cycle fatigue (HCF) model which treats all stress components in a unified manner and is suitable for arbitrary loading histories, thus liberating from the definition of an equivalent cycle, which is a severe drawback of many existing HCF models. Another benefit of the continuum based model is its natural extensibility to anisotropy, low-cycle fatigue, stochastic and stress gradient features [1, 4]. The basic ingredients of the continuum based HCF model are the endurance surface and the evolution equations for its movement and the fatigue damage.

The fatigue model of Ottosen et al. can be formulated either as a differential algebraic equation system (DAE) or as first order ordinary differential equation (ODE). Especially we are interested on the accuracy and performance of the backward difference method of order k (BDFk) and the discontinuous Galerkin method of degree q dG(q) [2]. Especially the dG-methods have possiblility to control the accuracy both in the asymptotic range and what is more important in practical computations when large time steps have to be used. Explicir Runge-Kutta type methods are also appealing for solving damage evolution problems.

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