Piecewise smooth dynamic simulations via algorithmic piecewise differentation

Tom Streubel (Zuse Institute Berlin), Andreas Griewank, Caren Tischendorf

Given some piecewise differentiable ODE, the order of consistency of any Runge-Kutta method or any multistep method will drop to 2 while crossing a non differentiability. We will discuss changes during the derivation of the midpoint rule and the trapezoidal method such that they attain their consistency order of 3 again. These modified versions of both integrators are considered to be nonsmooth generalizations in that they are still equivalent to their classical counterparts on sufficiently smooth systems of ODEs. We will discuss energy preservation and symplectic properties of both the classical and generalized midpoint rule for piecewise smooth Hamiltonian systems. We will conclude the talk with an outlook to semi explicit DAEs and the generalization of multistep methods based on piecewise polynomial Taylor expansions.