Half-Explicit Runge-Kutta Lie Group Integrators for Flexible Multibody Systems

Denise Tumiotto (Martin Luther University Halle-Wittenberg, Institute of Mathematics), Martin Arnold

When modelling geometrically exact beams under constraints, two problems arise: The presence of nonlinear configuration spaces for describing large rotations and the presence of algebraic variables coupled with differential ones. To obtain an efficient numerical solution for the latter problem, half-explicit Runge-Kutta methods have been introduced in 1992 by Brasey and Hairer. The current work adapts these half-explicit Runge-Kutta methods to solve index-2 DAEs in nonlinear configuration spaces, of the Lie group form, so that the first problem is covered. Nevertheless, a well-known issue, called drift-off effect, rises when evaluating the numerical solution of reduced index DAEs. Specifically, when reducing the index from 3 to 2 by differentiation of the constraints, we introduce new constraints at velocity level and numerical residuals in the constraints at position level. Previous techniques of projection or stabilization to avoid the drift-off effect are adapted to the case of interest. To conclude the study, numerical experiments on flexible structures modelled as Cosserat rods are performed.

[link to pdf] [back to Numdiff-17]