Multistep DAE integrators on Lie groups

Martin Arnold (Martin Luther University Halle-Wittenberg), Victoria Wieloch, Stefan Hante

R 3.28 Mon Z2 17:05-17:30

We consider the time discretization of differential equations on Lie groups by a class of multistep methods that define the solution updates in each time step by the exponential of solution increments in the corresponding Lie algebra. An increment representation of classical multistep methods proves to be favourable to define a Lie group specific correction term for updating the solution increments. This correction term does not require any extra effort for methods of order $p \leq 2$. Up to order $p = 4$, there is just one commutator to be evaluated in each time step which makes this approach more efficient than other multistep integrators for ODEs on Lie groups.
Our main interest is in the application to constrained systems on Lie groups. We discuss zero stability and convergence in the application to DAEs of index 2 and 3. The results of the theoretical investigations are verified by numerical tests for a benchmark problem and by a comparison with other Lie group integrators in the application to a semi-discretized rod model from nonlinear beam theory.