Split-explicit methods with a large number of explicit stages

Oswald Knoth (Institute for Tropospheric Research), Marco Müller

Split-explicit methods are a common integration method in numerical weather prediction. They combine two explicit methods to integrate different parts of the right hand side with different time steps. Common combinations are for the slow part Leap-Frog, Runge-Kutta, or Adams-method and for the fast part a Verlet-type integration method. For Runge-Kutta methods as the slow integrator Wensch et.al give a generalization (MIS-method) and analyzed this new method in case of an exact integration of the fast part. To improve the efficiency of the method we propose an optimization strategy to find low order methods (up to order 3) with a large number of explicit stages. The goal is to enlarge the stability region with respect to the number of function evaluations for the large and small steps. Different methods are compared for two-dimensional test examples used in numerical weather prediction.