On Singly Implicit Runge-Kutta Methods of High Stage Order that Utilize Effective Order

Tim Steinhoff (GRS gGmbH)

The abscissae c_i of a classical singly implicit Runge–Kutta method (SIRK) of order p, that also has a stage order of p, are tightly bound to the roots of the p-degree Laguerre polynomial. Utilizing the concept of effective order lifts this restriction allowing for arbitrary choices of c_i in principal. To provide further flexibility in terms of error constants and stability we discuss in this talk a combination of the effective order concept with SIRK methods, that are based on perturbed collocation. Furthermore, the concept of finite iteration is taken into account to ensure that a predefined number of Newton iteration steps suffices to meet the (effective) order of the corresponding fully implicit SIRK method.