

***Adaptive Order Strategies for Finite Iteration RK Methods of
High Stage Order***

Tim Steinhoff

(Gesellschaft für Anlagen- und Reaktorsicherheit (GRS) gGmbH)

Finite iteration Runge–Kutta (RK) methods are adaptations of fully implicit RK methods, where only a predefined number of Newton-like steps is executed. This is in analogy to Rosenbrock–Wanner methods, however, the basic idea is to exploit amiable properties of the underlying Newton process to ensure the same order p as the fully implicit method. High stage order (in relation to the overall order of the method) renders the method immune to order reduction phenomena and, additionally, helps with an adaptive order strategy.

The development of criteria to advocate a method of lower order is quite straightforward. On the other hand, to decide whether a method of higher order may be more suitable an estimate of the derivative $y_0^{(p+2)}$ is required, which is not readily available. This is especially true in the context of Finite iteration RK methods where additional perturbation terms may arise from the truncated Newton process. Taking these perturbations into account we present in this talk techniques and conditions to provide an estimate for $y_0^{(p+2)}$ in a concise way.