

# Some optimal Runge-Kutta collocation methods for Stiff problems and DAEs

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A new family of implicit Runge-Kutta methods will be introduced in ICCAM 2008 (Ghent) by the authors aforementioned. This family of methods is intended to solve numerically stiff problems and DAEs. The  $s$ -stage method (for  $s \geq 3$ ) has the following features: it is a collocation method depending on a real free parameter  $\alpha$ , has classical convergence order  $2s - 3$  and is strongly  $A$ -stable for  $\alpha$  ranging in some nonempty open interval  $I_s = (-\gamma_s, 0)$ . In addition, for  $\alpha \in I_s$ , all the collocation nodes fall in the interval  $[0, 1]$ . Moreover, these methods also involve similar computational costs that the corresponding counterpart in the Runge-Kutta Radau IIA family (the method having the same classical order) when solving for their stage values. However, our methods have the additional advantage of possessing a higher stage order than the Radau IIA counterpart. This circumstance is important when integrating stiff problems in which case most of numerical methods are affected by an order reduction in its convergence order. In this talk we discuss how to optimize the free parameter  $\alpha$  depending on the special features of the kind of stiff problems and DAEs to be considered. This point is highly important in order to make competitive our methods when compared with those of the Radau IIA family.

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