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Three-stage Peer methods for the numerical solution of second order IVPs

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SUMMARY

In this work, we solve numerically second order initial vale problems $y'' = f(t, y)$ by means of 3-stage explicit two-step Peer methods, given by

$$\begin{aligned} Y_{m+1} &= BY_m + hAZ_m + h^2QF_m + h^2RF_{m+1}, \\ Z_{m+1} &= \widehat{B}Z_m + h\widehat{Q}F_m + h\widehat{R}F_{m+1}, \end{aligned} \tag{1}$$

where the stage vectors evaluated at $t_{mi} = t_m + c_i h$ are

$$\begin{aligned} Y_m &= (Y_{mi}), \text{ where } Y_{mi} \simeq y(t_{mi}), \\ Z_m &= (Z_{mi}), \text{ where } Z_{mi} \simeq y'(t_{mi}), \\ F_m &= (f(t_{mi}, Y_{mi})), \end{aligned} \tag{2}$$

and B, A, Q, R, $\widehat{B}$, $\widehat{Q}$, $\widehat{R}$ denote the matrices $s \times s$ of the method, being R, $\widehat{R}$ strictly inferior triangular.

We propose a 3-stage method with one reused stage, so that only two effective function evaluations of the derivative are needed per step. We analyze the 0-stability, consistency and convergence of a particular scheme of order five.

Keywords: Second order equations, Peer methods, stability

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References

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