

Implicit peer methods with embedded sensitivities for parameter-dependent ODEs

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By design all stages of peer two-step methods possess the full order of the scheme. This property allows for the embedding of additional stages to approximate an arbitrary number of solution derivatives with respect to parameters of the ODE. In fact, one additional satellite stage is sufficient for each ODE parameter. With respect to the time stepsize the satellite stages have the full order of the original scheme, while the accuracy of computed parameter derivatives is of lower order only. Still, there is an improvement for implicit methods compared to explicit methods discussed previously. This embedding may be cheaper than the standard approach of solving neighbouring problems with the same basic numerical scheme. Numerical tests show that these derivatives are sufficiently accurate for Newton-type iterations in boundary value problems and parameter identification.