Design and implementation of a (4,5) DIRK formula pair for stiff systems

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Abstract

This talk describes the design of a new family of diagonally implicit Runge-Kutta (DIRK) formula pairs, each consisting of an integrator of order 4 and an ("asymptotically correct") error estimator of order 5. The fourth-order integrator has six stages, with the first (formally) explicit, and is stiffly accurate and L-stable. A continuously differentiable interpolant of order four is also available. Both the error estimator and the interpolant are "free," for they use only the stages computed by the basic integrator. The implementation requires only as much work per step as the well-known Hairer-Wanner code SDIRK4, a (4,3) DIRK formula pair. The implementation is compared to some well-known codes for performance on some challenging stiff problems.