Parallel exponential Rosenbrock methods

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Exponential Rosenbrock integrators have been shown to be very efficient in solving large stiff differential systems of ODEs. So far, such exponential methods have been derived up to order 5. In this talk we give a convergence result for methods of order up to 6 and construct new integrators of orders 4, 5, and 6. In contrast to the existing schemes of orders 4 and 5, the new schemes, which are called parallel stages methods, can be implemented on a multi-processor system or parallel computers. Moreover, the great advantage of the new schemes of orders 4 and 5, when compared to the old schemes of the same orders of accuracy, is that they use the same number of stages. This offers a significant improvement over the old schemes, which have the same orders, in terms of computational time when implemented in parallel. The numerical experiments show the efficiency of the new integrators as well as the comparative performance with the old ones.

Main references:

V. T. Luan and A. Ostermann, Exponential Rosenbrock methods of order five–derivation, analysis and numerical comparisons, J. Comput. Appl., 255, 417–431 (2014).

V. T. Luan and A. Ostermann, Exponential B-series: The stiff case, *SIAM J. Numer. Anal.* **51**(6), 3431–3445, (2013).