

On this ROCK I will Build my Stiff Integrators

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The numerical solution of stiff differential equations must usually be done with implicit (Runge-Kutta) methods, to the theory of which Michel Crouzeix has made so many important contributions. However, when the system becomes very large or complicated, these methods, which require to compute a large derivative matrix and to solve frequently large linear systems, become very costly.

In such cases, the approach by stabilized explicit methods can become very interesting. In the methods which we describe, two independent traditions are brought together: on the one side the Runge-Kutta-Chebyshev (RKC) methods of order 1 and 2 developed mainly by Verwer, van der Houwen, Hundsdorfer and Sommeijer in Amsterdam, on the other side the second order methods based on Zolotarief polynomials by Lebedev and Medovikov in Moscow. By introducing a certain orthogonality condition ("O", which transforms the RKC to ROCK), one is able to combine the optimal stability of the Lebedev tradition with the recurrence relation of the Amsterdam tradition. Finally, by applying the Butcher group, one is able to increase the precision considerably by raising the order to 4 (see [1]).

The talk intends to explain these steps and to present recent practical applications of the method.

References

- [1] A. ABDULLE, *Fourth Order Chebyshev Methods with Recurrence Relation*, SISC, Vol.23, pp. 2041-2054, 2002.

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