Two-step Runge-Kutta-Chebyshev methods

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Chebyshev (or stabilized) methods are explicit Runge-Kutta methods with extended stability domains along the negative real axis. These methods are intended for large mildly stiff problems, originating mainly from parabolic PDEs.
Two main families of stabilized methods are the most commonly used today:

- Runge-Kutta-Chebyshev methods proposed by van der Houwen & Sommeijer (1980);
- Orthogonal-Runge-Kutta-Chebyshev methods proposed by Abdulle & Medovikov (2001) and Abdulle (2002).

In this talk we consider a new family of two-step Runge-Kutta-Chebyshev methods. It contains

- the second order methods with larger stability intervals than of the one-step methods of this order [1];
- the first-ever third order methods with the closed analytic stability polynomials.

We reveal their theoretical properties, advantages and disadvantages. Also, we discuss the results of numerical experiments and the comparison with widely-known stabilized codes.

References

1. A. Moisa, A family of two-step second order Runge–Kutta–Chebyshev methods, Journal of Computational and Applied Mathematics 446 (2024). doi:10.1016/j.cam.2024.115868.

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