

GENERAL LINEAR NYSTRÖM METHODS

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In this talk we describe the family of General Linear Nyström methods (GLNs), which provides the extension of the family of General Linear Methods for the numerical solution of first order Ordinary Differential Equations (ODEs) [1, 2] to special second order ODEs. The family of GLNs properly includes all the classical methods already considered in the literature for $y'' = f(x, y)$, such as linear multistep methods, Runge-Kutta-Nyström methods, two-step hybrid methods and two-step Runge-Kutta-Nyström methods as special cases. The family of methods we aim to consider is wider and more general with respect to the ones already considered in the literature: in fact, our new methods depend on more parameters which can be exploited, for instance, in order to provide a better balance between order of convergence and stability properties. At the same time, the theory of GLNs allows to provide an unifying approach for the analysis of the properties of convergence, consistency and stability. We present the re-formulation of the classical methods according to the new approach and the main results regarding consistency, zero-stability, convergence, order conditions and linear stability theory. Using GLNs theory, new examples of numerical methods for second order ODEs are introduced and discussed. The approach we will use is the natural extension of the General Linear Methods theory developed for first order ODEs [1, 2].

References

- [1] J.C. Butcher, *Numerical Methods for Ordinary Differential Equations*, 2nd Edition, John Wiley & Sons, Chichester, 2008.
- [2] Z. Jackiewicz, *General Linear Methods for Ordinary Differential Equations*, John Wiley & Sons, Hoboken, New Jersey, 2009.