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Fine Tuning Numerical Schemes for PDEs

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Abstract

The main goal of geometric integration is to reproduce, in a numerical approximation, key geometric properties of a given continuous differential problem. In the numerical treatment of partial differential equations, the benefits of conserving global integral invariants are well-known. Preserving the underlying local conservation laws gives, in general, stricter constraints.

Recently, a new approach has been introduced to develop bespoke finite difference schemes that preserve conservation laws [1,2]. The schemes obtained in this way typically feature certain free parameters that can be arbitrarily chosen.

A convenient choice of the parameters yields to very accurate approximations. However, the parameters' optimal values are not available a priori and depend heavily on the initial conditions. A new procedure for identifying their optimal values is discussed in this talk.

References

[1] G. Frasca-Caccia, P. E. Hydon. Simple bespoke preservation of two conservation laws. *IMA J. Numer. Anal.*, **40** (2020), 1294–1329.
[2] G. Frasca Caccia, P. E. Hydon. A new technique for preserving conservation laws. *Found. Comput. Math.*, **22** (2022), 477–506.

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