A structure-preserving wavelet collocation method for nonlinear partial differential equations

Yuto Miyatake
The University of Tokyo
7-3-1 Hongo, Bunkyo-ku, Tokyo
Japan
yuto_miyatake@mist.i.u-tokyo.ac.jp

Joint work with: T. Matsuo

In the field of numerical integration of partial differential equations (PDEs), structure-preserving numerical methods have been attracting much attention. Typical targets are PDEs that enjoy the energy conservation/dissipation or multi-symplectic property, and there are several frameworks to derive schemes that inherit such properties. In most frameworks, one firstly discretize PDEs appropriately in space to get ordinary differential equations (ODEs) inheriting the original properties, and then discretize them in time by applying a structure-preserving method known in the ODE context such as the discrete gradient method (DGM) [3] or symplectic method [1].

As one example, let us take the discrete variational derivative method (DVDM) [2] which is a unified approach to derive conservative/dissipative schemes. Briefly speaking, the DVDM is the DGM combined with a certain spatial discretization technique. The spatial discretization technique has been based on FDM and FEM so far, but they seem not adequate for singular solutions such as shock solutions. Since wavelet based methods are known to be useful for such solutions, it seems natural to reconstruct the DVDM based on wavelets. In this talk we present a reconstructed DVDM based on wavelet collocation method, motivated by [4,5].

References

Keywords: Computational physics and chemistry, Partial differential equations, Discrete gradient method, Wavelet collocation method.