Hyperbolic description of dispersive and dissipative phenomena

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Résumé

Conservative hyperbolic systems of equations (Euler equations of compressible fluids, MHD equations, Saint-Venant equations...) constitute a class of mathematical models having a simple mathematical structure. The corresponding characteristic surfaces are real and have a clear physical meaning. Efficient numerical methods based on the solution of the Riemann problem for the corresponding conservative hyperbolic models (Godunov type methods) and their extensions has been developed since for many years.
The idea to transform the dissipative equations into a hyperbolic relaxation system belongs probably to Cattaneo who transformed the heat equation into a system exhibiting a finite velocity for the heat propagation. I will present a recent achievement in this field performed by I. Peshkov and E. Romensky for the Navier-Stokes equations. They proposed a hyperbolic relaxation system describing not only fluids, but also solids.
I will discuss then a hyperbolic regularization of dispersive systems based on the concept of a generalized Lagrangian, where a sort of penalization technique is developed. As examples, the Serre-Green-Naghdi equations for water waves and non-linear defocusing Schrodinger equation appearing as an approximate model of thin films, will be presented.

Mots-Clés: hyperbolic systems of equations, dispersive and dissipative phenomena

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