Symmetric hyperbolic equations for modeling of non-Newtonian flows

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Recently, a unified first order hyperbolic formulation of continuum mechanics was discussed in [1, 2, 3]. Such a model is based on a nonlinear hyperbolic model proposed by Godunov and Romenski in the 1970s [4] for modeling of elastoplastic deformations in solids. Our approach can describe the two main branches of continuum mechanics, fluid and solid dynamics in a single system of hyperbolic partial differential equations which. This time, we discuss the model applicability to describe non-Newtonian flows and in particular to the modeling of elastoviscoplastic flows which exhibits properties of both viscous fluids and elastic solids. One of the attractive features of our model is that it is globally hyperbolic because it can be cast into a symmetric hyperbolic form. We recall that the hyperbolicity means that the initial value problem is well-posed despite how nonlinear a model might be and thus it can be effectively solved numerically. Also, note that the discussed hyperbolic model is fundamentally different from the conventional nonlinear parabolic models for non-Newtonian flows such as Bingham model or Herschel-Bulkley model employing the nonlinear viscosity approach. This is a joint work with Michael Dumbser (U. of Trento, Italy) and Evgeniy Romenski (Sobolev Inst. of Math., Russia).
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Références

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