Relaxation approximation for hyperbolic fluid systems

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This presentation is devoted to the relaxation approximation of systems of conservation laws which fall into in the canonical frame of fluid systems proposed by Després. More precisely, such systems, when written in Lagrangian coordinates, verify the following requirements: Galilean invariance, reversibility for smooth solutions and their entropy flux is zero. Euler system of compressible gas dynamics, multi-species multi-temperature models, models of ideal magnetohydrodynamics... are some of the systems which fulfill these hypotheses.

The aim of this work is to develop a relaxation approximation of such systems, from both a theoretical and a numerical point of view. Such an idea has already been proposed by Jin and Xin, using a global linearization of the system. Here, we take advantage of the structure of the system, which allows us to separate the linearly degenerate part and the fully nonlinear part of the system. Then, we perform a relaxation approximation on the nonlinear part. This approximation leads to a linearly degenerate system with a relaxation source term (see the works of Suliciu, of Coquel *et al.* and the Bouchut's book for similar works in the case of gas dynamics).

From the theoretical point of view, this approximation verifies a Gibbs principle and we can show that it falls into the general theory of relaxation developed in the last few years (see for instance the Yong's works). From the numerical point of view, this approach enables us to construct conservative, entropy satisfying and positive Finite Volume schemes. Several examples of applications will be presented with explicit constructions of numerical schemes.