Dynamics of relaxed compressible Navier-Stokes equations

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We investigate the formation of singularities in one-dimensional hyperbolic compressible Navier-Stokes equations, a model proposing a relaxation leading to a hyperbolization through a nonlinear Cattaneo law for heat conduction as well as through the constitutive Maxwell type relations for the stress tensor. By using the entropy dissipation inequality, which gives the lower energy estimates of the local solutions without any smallness condition on initial data, and by constructing some useful averaged quantities we show that there are in general no global C^1 solutions for the studied system with some large initial data.

This appears as a remarkable contrast to the situation without relaxation, i.e. for the classical compressible Navier-Stokes equations, where global large solutions exist. It also contrasts the fact that for the linearized system associated to the classical resp. relaxed compressible Navier-Stokes equations, the qualitative behavior is exactly the same: exponential stability in bounded domains and polynomial decay without loss of regularity for the Cauchy problem.