ID de Contribution: **16** Type: **Non spécifié**

Dissipative hyperbolic systems and their diffusion large-time behaviors: Linear cases

mercredi 11 juillet 2018 11:15 (30 minutes)

Dissipative hyperbolic systems play a central role in many applications including the kinetic models for gas dynamics and the relaxation numerical schemes approximating conservation laws. One important feature of this kind of systems is the diffusion limit of solution as time tends to infinity. In this talk, we will discuss some reasonable dissipative structures such that for large time, the unique solution to the initial value problem for

$\partial_t u + \sum_{j=1}^d A_j \partial_{x_j} u + Bu = 0$

is approximated by a solution to the initial value problem for a parabolic system, where A_j and B are $n \times n$ matrices with real constant entries, and $u = u(x,t)$ is an n-dimensional real vector. The approximation is of order $\mathcal{O}\big(t^{-\frac{d}{2}(\frac{1}{q}-\frac{1}{p})-\alpha}\big)$ for $\alpha \in \{1/2, 1\}$ and $1 \leq q \leq p \leq \infty$, up to an exponentially decaying error. This optimal result in [mascianguyen17,nguyen18] is a generalization of [bianchini07] at the linear level. The main idea is based on the perturbation theory for linear operators and the Fourier analysis.

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[bianchini07] S. Bianchini, B. Hanouzet and R. Natalini, Asymptotic behavior of smooth solutions for partially dissipative hyperbolic systems with a convex entropy, Comm. Pure Appl. Math., 60 (2007), 1559 – 1622.

[mascianguyen17] C. Mascia and T. T. Nguyen, L^p-L^q decay estimates for dissipative linear hyperbolic systems in 1D, J. Differential Equations, 263 (2017), 6189 – 6230.

[nguyen18] T. T. Nguyen, Asymptotic limit and decay estimates for a class of dissipative linear hyperbolic systems in several dimensions, Discrete Contin. Dyn. Syst., (to appear).

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