

High Resolution, Negative Norms and the Convergence of Central Schemes

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ABSTRACT

In recent decades there has been an enormous amount of activity related to the construction and analysis of algorithms for the approximate solution of nonlinear, time-dependent partial differential equations (PDEs), most notably, nonlinear PDEs whose solutions spontaneously change their scales. To present some aspects of this work I will discuss a few of the analytical tools used in convergence theories for these algorithms.

One usually relies on the fact that stability implies convergence. But for certain nonlinear approximations one can do with less. To make the point, I focus attention on one family of approximations -- finite difference approximations based on central schemes. The new argument shows that weak regularity of the approximate solutions is sufficient for convergence. The main tool is a estimate of the error in a *negative norm*. Convergence for high-resolution approximations follows, as do error estimates.