Approximate Solutions of Fluid Dynamics Equations

Eitan TADMOR
Department of mathematics, UCLA

Abstract

Many problems encountered in Fluid Dynamics are governed by nonlinear PDEs whose solutions experience spontaneous evolution of two or more different scales, due to concentration effects, shock discontinuities, development of thin layers etc. The formation of such different scales leads to challenging difficulties in the construction and analysis of approximate solutions for these problems. On the computational side there are unresolved small scales which require a careful balance between high-resolution and stability. On the theoretical side there is loss of (global) regularity which requires a careful study of convergence and error analysis.

We discuss how modern algorithms in Computational Fluid Dynamics (CFD) address these difficulties: the construction of high-resolution approximate methods for piecewise-smooth solutions, the convergence analysis of these methods for appropriate low regularity spaces, and the interplay between the theory of exact regularity spaces and the computational aspects of the approximate methods.