Lions, Pierre-Louis

Mathematical topics in fluid mechanics. Vol. 2: Compressible models. (English)

Zbl 0908.76004

Oxford Lecture Series in Mathematics and its Applications. 10. Oxford: Clarendon Press. xiv, 348 p. (1998).

Unlike the first volume [the author, Mathematical topics in fluid mechanics. Vol. 1: Incompressible models (1996; Zbl 0866.76002)] devoted to incompressible fluid flows, this volume is entirely concerned with new results on compressible equations of fluid mechanics. This research monograph cover a variety issues associated with compressible models. The proofs of results are basically self-contained and many technical prerequisites from analysis are not assumed from the reader. The first chapter is concerned with compactness results for compressible isentropic Navier-Stokes equations. Then the author treats stationary problems and time-discretized problems. He derives some necessary a priori estimates, then he analyzes the compactness of sequences of solutions and finally concludes with the construction of solutions using ad hoc approximations. In the next chapter the author proves existence of global weak solutions. The proof is based on some new a priori bounds on the density. The last chapter contains results (and their proofs) on various related problems: pure transport of entropy, a semi-stationary and shallow water models, models with temperature, compressible Euler equations and others. To prove existence results, in some especially difficult cases the author needs to postulate some bounds (which are not known yet).

Summarizing the impression of this interesting book, it is worth pointing out that the book is written in an easy-reading fashion along with deep and comprehensive analysis of compressible flows.

Reviewer: P.B.Dubovskiĭ (Moskva)

MSC:

76-02 Research exposition (monographs, survey articles) pertaining to fluid mechanics
76N10 Existence, uniqueness, and regularity theory for compressible fluids and gas dynamics
35Q30 Navier-Stokes equations
35Q35 PDEs in connection with fluid mechanics

Keywords:

isentropic Navier-Stokes equations; stationary problems; compactness; time-discretized problems; a priori estimates; existence; global weak solutions; transport of entropy; regularization; shallow water models; Euler equations