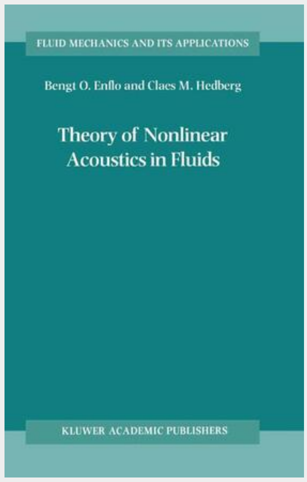
Hedberg / Enflo

Theory of Nonlinear Acoustics in Fluids



The aim of the present book is to present theoretical nonlinear aco- tics with equal stress on physical and mathematical foundations. We have attempted explicit and detailed accounting for the physical p- nomena treated in the book, as well as their modelling, and the f- mulation and solution of the mathematical models. The nonlinear acoustic phenomena described in the book are chosen to give phy- cally interesting illustrations of the mathematical theory. As active researchers in the mathematical theory of nonlinear acoustics we have found that there is a need for a coherent account of this theory from a unified point of view, covering both the phenomena studied and mathematical techniques developed in the last few decades. The most ambitious existing book on the subject of theoretical nonlinear acoustics is "Theoretical Foundations of Nonlinear Aco- tics" by O. V. Rudenko and S. I. Soluyan (Plenum, New York, 1977). This book contains a variety of applications mainly described by Bu- ers' equation or its generalizations. Still adhering to the subject - scribed in the title of the book of Rudenko and Soluyan, we attempt to include applications and techniques developed after the appearance of, or not included in, this book. Examples of such applications are resonators, shockwaves from supersonic projectiles and travelling of multifrequency waves. Examples of such techniques are derivation of exact solutions of Burgers' equation, travelling wave solutions of Bu- ers' equation in non-planar geometries and analytical techniques for the nonlinear acoustic beam (KZK) equation.

This book presents theoretical nonlinear acoustics in fluids with equal stress on physical foundations and mathematical methods. From first principles in fluid mechanics and thermodynamics a universal mathematical model (Kuznetsov's equation) of nonlinear acoustics is developed. This model is applied to problems such as nonlinear generation of higher harmonics and combination frequencies, the shockwave from a supersonic projectile, propagation of shocks in acoustic beams and nonlinear standing waves in resonators. Special for the book is the coherent account of nonlinear acoustic theory from a unified point of view and the detailed presentations of the mathematical techniques for solving the nonlinear acoustic model equations. The book differs from mathematical books on nonlinear wave equations by its stress on their origin in physical principles and their use for physical applications. It differs from books on applications of nonlinear acoustics by its ambition to explain all steps in mathematical derivations of physical results. It is useful for practicians and researchers in acoustics feeling the need for more theoretical understanding. It can be used as a textbook for graduate or advanced undergraduate students with an adequate background in physics and mathematical analysis, specializing in acoustics, mechanics or applied mathematics.

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