

Mathematics

SHOCK WAVES AND EXPLOSIONS

While offering an introductory review of historic research, ***Shock Waves and Explosions*** brings analytic and computational methods to a wide audience in a clear and thorough way. Beginning with an overview of the research on combustion and gas dynamics by Korobeinikov and Zeldovich in the 1970s and 1980s, the author brings you up to date on modeling techniques and asymptotic and perturbative methods, ending with a chapter on computational methods.

Most of the book deals with the mathematical analysis of explosions, but computational results also are included wherever available. Historical perspectives are provided on the advent of nonlinear science, as well as the mathematical study of the blast wave phenomenon, both when visualized as a point explosion and when simulated as the expansion of a high-pressure gas.

Features

- Offers an introductory review of historic research in the field
- Presents a clear treatment of perturbation and asymptotic methods
- Includes new methods not included in other texts

This volume clearly reveals the ideas and techniques in conceptualizing, modeling, and mathematically analyzing highly complicated nonlinear phenomena involved in shock waves and explosions.

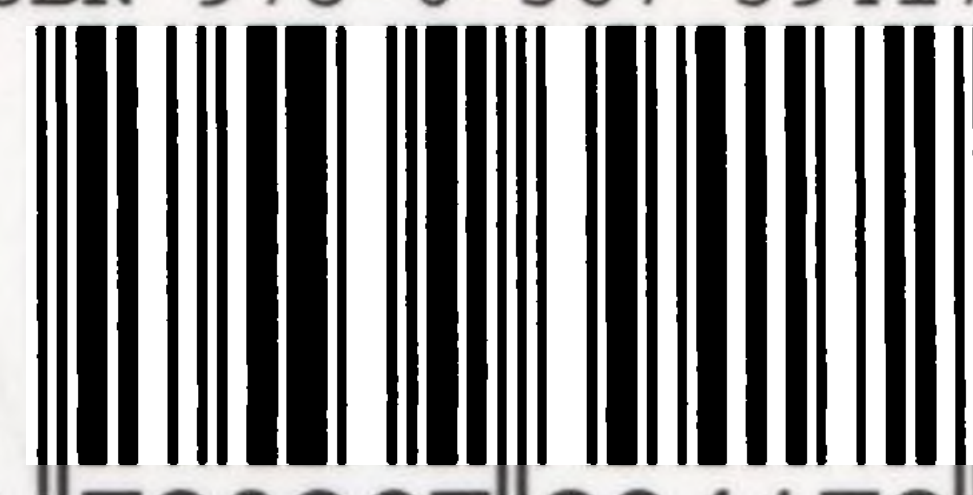


CRC Press

Taylor & Francis Group
an informa business

www.crcpress.com

ISBN 978-0-367-39417-2



9 780367 394172

Preface	ix
Acknowledgements	x
1 Introduction	1
2 The Piston Problem	15
2.1 Introduction	15
2.2 The Piston Problem: Its Connection with the Blast Wave . .	17
2.3 Piston Problem in the Phase Plane	23
2.4 Cauchy Problem in Relation to Automodel Solutions of One-Dimensional Nonsteady Gas Flows	28
2.5 Uniform Expansion of a Cylinder or Sphere into Still Air: An Analytic Solution of the Boundary Value Problem	33
2.6 Plane Gas Dynamics in Transformed Co-ordinates	37
3 The Blast Wave	49
3.1 Introduction	49
3.2 Approximate Analytic Solution of the Blast Wave Problem Involving Shocks of Moderate Strength	56
3.3 Blast Wave in Lagrangian Co-ordinates	79
3.4 Point Explosion in an Exponential Atmosphere	90
3.5 Asymptotic Behaviour of Blast Waves at a High Altitude . .	99
3.6 Strong Explosion into a Power Law Density Medium	103
3.7 Strong Explosion into Power Law Nonuniform Medium: Self- similar Solutions of the Second Kind	110
3.8 Point Explosion with Heat Conduction	118
3.9 The Blast Wave at a Large Distance	130

4	Shock Propagation Theories: Some Initial Studies	137
4.1	Shock Wave Theory of Kirkwood and Bethe	137
4.2	The Brinkley-Kirkwood Theory	144
4.3	Pressure Behind the Shock: A Practical Formula	150
5	Some Exact Analytic Solutions of Gasdynamic Equations Involving Shocks	153
5.1	Exact Solutions of Spherically Symmetric Flows in Eulerian Co-ordinates	153
5.2	Exact Solutions of Gasdynamic Equations in Lagrangian Co- ordinates	163
5.3	Exact Solutions of Gasdynamic Equations with Nonlinear Particle Velocity	170
6	Converging Shock Waves	177
6.1	Converging Shock Waves: The Implosion Problem	177
6.2	Spherical Converging Shock Waves: Shock Exponent via the Pressure Maximum	183
6.3	Converging Shock Waves Caused by Spherical or Cylindrical Piston Motions	188
7	Spherical Blast Waves Produced by Sudden Expansion of a High Pressure Gas	195
7.1	Introduction	195
7.2	Expansion of a High Pressure Gas into Air: A Series Solution	197
7.3	Blast Wave Caused by the Expansion of a High Pressure Gas Sphere: An Approximate Analytic Solution	208
8	Numerical Simulation of Blast Waves	225
8.1	Introduction	225
8.2	A Brief Review of Difference Schemes for Hyperbolic Systems	228
8.3	Blast Wave Computations via Artificial Viscosity	233
8.4	Converging Cylindrical Shock Waves	242
8.5	Numerical Simulation of Explosions Using Total Variation Diminishing Scheme	253
	References	265
	Index	275