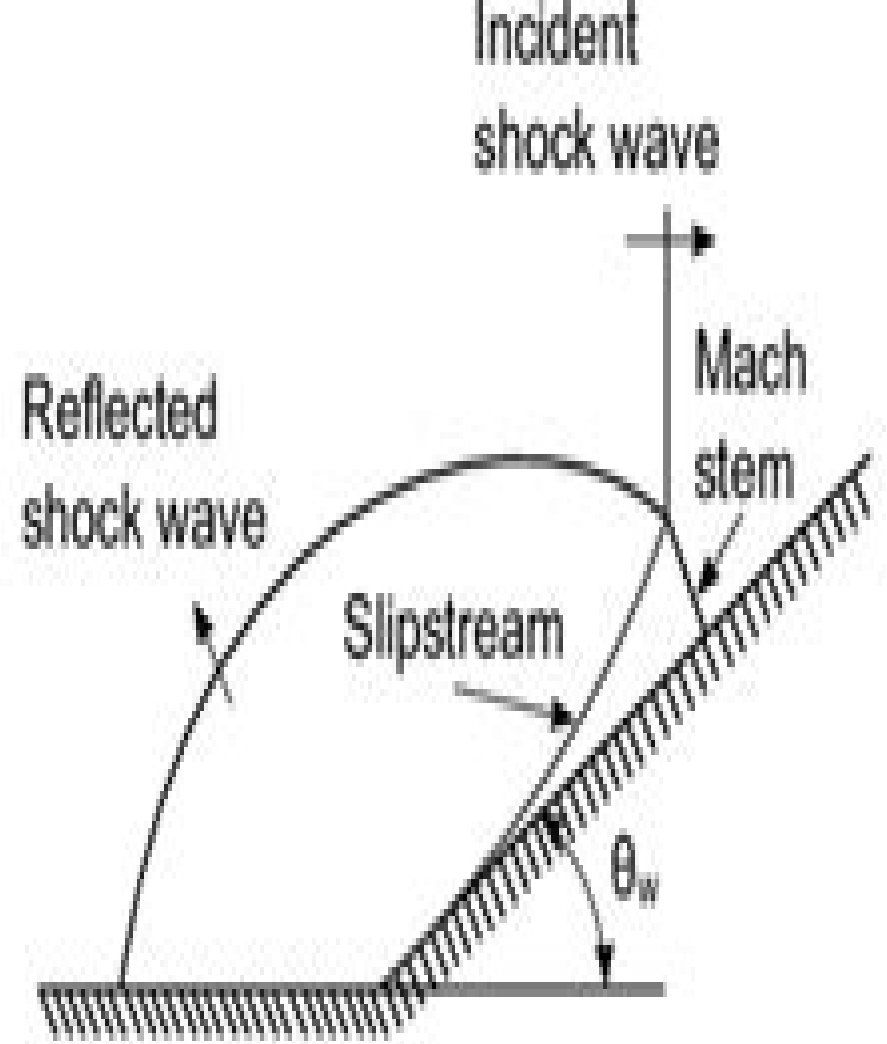


(a) Regular shock wave reflection



(b) Irregular shock wave reflection

Shock Wave Reflection Phenomena

Jerry W Forbes



Shock Wave Reflection Phenomena:

Shock Wave Reflection Phenomena Gabi Ben-Dor, 2013-06-29 The phenomenon of shock wave reflection was first reported by the distinguished philosopher Ernst Mach in 1878 Its study was then abandoned for a period of about 60 years until its investigation was initiated in the early 1940s by Professor John von Neumann and Professor Bleakney Under their supervision 15 years of intensive research related to various aspects of the reflection of shock waves in pseudo steady flows were carried out It was during this period that the four basic shock wave reflection configurations were discovered Then for a period of about 10 years from the mid 1950s until the mid 1960s investigation of the reflection phenomenon of shock waves was kept on a low flame all over the world e g Australia Japan Canada U S A U S S R etc until Professor Bazhenova from the U S S R Professor Irvine Glass from Canada and Professor Roy Henderson from Australia re initiated the study of this and related phenomena Under their scientific supervision and leadership numerous findings related to this phenomenon were reported Probably the most productive research group in the mid 1970s was that led by Professor Irvine Glass in the Institute of Aerospace Studies of the University of Toronto In 1978 exactly 100 years after Ernst Mach first reported his discovery of the reflection phenomenon I published my Ph D thesis in which for the first time analytical transition criteria between the various shock wave reflection configurations were established

Shock Wave Reflection Phenomena Gabi Ben-Dor, 2007-08-28 This book is a comprehensive state of the knowledge summation of shock wave reflection phenomena from a phenomenological point of view It includes a thorough introduction to oblique shock wave reflections dealing with both regular and Mach types It also covers in detail the corresponding two and three shock theories The book moves on to describe reflection phenomena in a variety of flow types as well as providing the resolution of the Neumann paradox

Impact of Roughness on Shock Wave Reflection Phenomena Thomas Lechat, Sébastien Ollivier, Didier Dragna, Maria Karzova, 2019

Mathematical Analysis of Shock Wave Reflection Shuxing Chen, 2020-09-04 This book is aimed to make careful analysis to various mathematical problems derived from shock reflection by using the theory of partial differential equations The occurrence propagation and reflection of shock waves are important phenomena in fluid dynamics Comparing the plenty of studies of physical experiments and numerical simulations on this subject this book makes main efforts to develop the related theory of mathematical analysis which is rather incomplete so far The book first introduces some basic knowledge on the system of compressible flow and shock waves then presents the concept of shock polar and its properties particularly the properties of the shock polar for potential flow equation which are first systematically presented and proved in this book Mathematical analysis of regular reflection and Mach reflection in steady and unsteady flow are the most essential parts of this book To give challenges in future research some long standing open problems are listed in the end This book is attractive to researchers in the fields of partial differential equations system of conservation laws fluid dynamics and shock theory

Shock Waves - Proceedings Of The 20th International Symposium (In 2 Volumes) Hans G

Hornung, Joseph E Shepherd, Bradford Sturtevant, 1997-01-22 The symposia take place every two years They are the forum at which scientists concerned with shock waves present their research They USE shock waves for chemical kinetics studies for materials studies and smashing kidney stones they STUDY the phenomena associated with flows involving shock waves such as supersonic flow explosions detonations volcanic eruptions and in this symposium even such with it topics as impact of Shoemaker Levy on Jupiter and blast waves in the World Trade Center They also discover new bigger and better ways of generating flows at hypervelocity speeds and develop their technological tools further The international exchange of information is documented in the proceedings volumes which have become a storehouse of information on the subject documenting the history of this peculiar branch of science that involves chemists physicists engineers geophysicists material scientists and biologists

Shock Waves Klaus Hannemann, Friedrich Seiler, 2009-04-05 The 26th International Symposium on Shock Waves in G ttingen Germany was jointly organised by the German Aerospace Centre DLR and the French German Research Institute of Saint Louis ISL The year 2007 marked the 50th anniversary of the Symposium which first took place in 1957 in Boston and has since become an internationally acclaimed series of meetings for the wider Shock Wave Community The ISSW26 focused on the following areas Shock Propagation and Reflection Detonation and Combustion Hypersonic Flow Shock Boundary Layer Interaction Numerical Methods Medical Biological and Industrial Applications Richtmyer Meshkov Instability Blast Waves Chemically Reacting Flows Diagnostics Facilities Flow Visualisation Ignition Impact and Compaction Multiphase Flow Nozzles Flows Plasmas and Propulsion The two Volumes contain the papers presented at the symposium and serve as a reference for the participants of the ISSW 26 and individuals interested in these fields

Shock Wave Interactions Konstantinos Kontis, 2018-03-28 This edited monograph contains the proceedings of the International Shock Interaction Symposium which emerged as an heir to both the Mach Reflection and Shock Vortex Interaction Symposia These scientific biannual meetings provide an ideal platform to expose new developments and discuss recent challenges in the field of shock wave interaction phenomena The goal of the symposia is to offer a forum for international interaction between young and established scientists in the field of shock and blast wave interaction phenomena The target audience of this book comprises primarily researchers and experts in the field of shock waves but the book may also be beneficial for young scientists and graduate students alike

Handbook of Shock Waves, Three Volume Set Gabi Ben-Dor, Ozer Igra, Tov Elperin, 2000-10-18 The Handbook of Shock Waves contains a comprehensive structured coverage of research topics related to shock wave phenomena including shock waves in gases liquids solids and space Shock waves represent an extremely important physical phenomena which appears to be of special practical importance in three major fields compressible flow aerodynamics materials science and astrophysics Shock waves comprise a phenomenon that occurs when pressure builds to force a reaction i e sonic boom that occurs when a jet breaks the speed of sound This Handbook contains experimental theoretical and numerical results which never before appeared under one cover the first handbook of its kind The Handbook

of Shock Waves is intended for researchers and engineers active in shock wave related fields Additionally R D establishments applied science research laboratories and scientific and engineering libraries both in universities and government institutions As well as undergraduate and graduate students in fluid mechanics gas dynamics and physics Key Features Ben Dor is known as one of the founders of the field of shock waves Covers a broad spectrum of shock wave research topics Provides a comprehensive description of various shock wave related subjects First handbook ever to include under one separate cover experimental theoretical and numerical results

30th International Symposium on Shock Waves 1 Gabi Ben-Dor,Oren Sadot,Ozer Igra,2017-08-09 These proceedings collect the papers presented at the 30th International Symposium on Shock Waves ISSW30 which was held in Tel Aviv Israel from July 19 to July 24 2015 The Symposium was organized by Ortra Ltd The ISSW30 focused on the state of knowledge of the following areas Nozzle Flow Supersonic and Hypersonic Flows with Shocks Supersonic Jets Chemical Kinetics Chemical Reacting Flows Detonation Combustion Ignition Shock Wave Reflection and Interaction Shock Wave Interaction with Obstacles Shock Wave Interaction with Porous Media Shock Wave Interaction with Granular Media Shock Wave Interaction with Dusty Media Plasma Magnetohydrodynamics Re entry to Earth Atmosphere Shock Waves in Rarefied Gases Shock Waves in Condensed Matter Solids and Liquids Shock Waves in Dense Gases Shock Wave Focusing Richtmyer Meshkov Instability Shock Boundary Layer Interaction Multiphase Flow Blast Waves Facilities Flow Visualization and Numerical Methods The two volumes serve as a reference for the participants of the ISSW30 and anyone interested in these fields

History of Shock Waves, Explosions and Impact Peter O. K. Krehl,2008-09-24 This unique and encyclopedic reference work describes the evolution of the physics of modern shock wave and detonation from the earlier and classical percussion The history of this complex process is first reviewed in a general survey Subsequently the subject is treated in more detail and the book is richly illustrated in the form of a picture gallery This book is ideal for everyone professionally interested in shock wave phenomena

29th International Symposium on Shock Waves 2 Riccardo Bonazza,Devesh Ranjan,2015-07-10 This proceedings present the results of the 29th International Symposium on Shock Waves ISSW29 which was held in Madison Wisconsin U S A from July 14 to July 19 2013 It was organized by the Wisconsin Shock Tube Laboratory which is part of the College of Engineering of the University of Wisconsin Madison The ISSW29 focused on the following areas Blast Waves Chemically Reactive Flows Detonation and Combustion Facilities Flow Visualization Hypersonic Flow Ignition Impact and Compaction Industrial Applications Magnetohydrodynamics Medical and Biological Applications Nozzle Flow Numerical Methods Plasmas Propulsion Richtmyer Meshkov Instability Shock Boundary Layer Interaction Shock Propagation and Reflection Shock Vortex Interaction Shock Waves in Condensed Matter Shock Waves in Multiphase Flow as well as Shock Waves in Rarefield Flow The two Volumes contain the papers presented at the symposium and serve as a reference for the participants of the ISSW 29 and individuals interested in these fields

Explosion Shock Waves and High Strain Rate Phenomena K. Hokamoto,K. Raghukandan,2019-08-20 The book presents

the papers presented at the 6th international conference on Explosion Shock Wave and High Strain Rate Phenomena ESHR. Topics covered include Advanced Manufacturing under Impact Shock Loading Detonation of High Pressure Flammable Gas in Closed Spaces High Strain Rate Behaviour of Auxetic Cellular Structures Underwater Shock Waves Generation Magnetic Pressure Welding of Aluminum Sheets Shock Synthesis of Zirconium Oxides Impact Joining of Dissimilar Metals High Speed Oblique Collision of Metals Dynamic Behavior of Dislocation Wall Structures Tensile Strength of Rock at High Strain Rates Fiber Reinforced Mortar Impact Analysis of Carbon Fiber Reinforced Polymer Explosive Welding Underwater Explosive Welding Making Ultrafine Explosives Aluminum Steel Explosive Cladding Explosively Cladded Aluminum Hybrid Composites Explosive Clads with Interlayers

Visualization of Shock Wave Phenomena Kazuyoshi Takayama, 2019-07-03 This book presents a wealth of images of shock wave phenomena gathered by the author over the past 40 years Shadowgrams and interferograms of basic shock dynamic topics such as reflection diffraction refraction and focusing of shock waves in gases and liquids are sequentially displayed Though the images themselves are self explanatory brief explanations of the experimental conditions are included so as to facilitate analysis and numerical reproduction of the image data In addition the book presents interferometric observations of underwater shock wave bubble interactions and highlights the multifaceted applications of shock wave phenomena to medicine and industry Given its scope the book offers a unique resource for students and researchers who are interested in shock wave phenomena However the content has also been specifically prepared for the benefit of readers who are interested in gas dynamics and medical applications of shock waves and are looking for reliable experimental images

Professor I. I. Glass: A Tribute and Memorial Kazuyoshi Takayama, Ozer Igra, 2012-10-16 The book provides personal memories along with description of scientific works written by ex graduate students and research associates of the late Professor Glass The described research work covers a wide range of shock wave phenomena resulting from seeds planted by Professor Glass Professor Glass was born in Poland in 1918 He immigrated together with his parents to Canada at the age of 12 and received all his professional education at the University of Toronto Canada He became a world recognized expert in shock wave phenomena and during his 45 years of active research he supervised more than 125 master and doctoral students post doctoral fellows and visiting research associates In this book seven of his past students research associates describe their personal memories of Professor Glass and present some of their investigations in shock wave phenomena which sprung from their past work with Professor Glass Specifically these investigations include underwater shock waves shock bubble interaction medical applications of shock wave various types of shock tubes and shock tube techniques shock wave attenuation and different types of shock wave reflections

Static Compression of Energetic Materials Suhithi M. Peiris, Gasper J. Piermarini, 2009-01-03 Developing and testing novel energetic materials is an expanding branch of the materials sciences Reaction detonation or explosion of such materials invariably produce extremely high pressures and temperatures To study the equations of state EOS of energetic materials in

extreme regimes both shock and static high pressure studies are required The present volume is an introduction and review of theoretical experimental and numerical aspects of static compression of such materials Chapter 1 introduces the basic experimental tool the diamond anvil pressure cell and the observational techniques used with it such as optical microscopy infrared spectrometry and x ray diffraction Chapter 2 outlines the principles of high nitrogen energetic materials synthesis Chapters 3 and 4 examine and compare various EOS formalisms and data fitting for crystalline and non crystalline materials respectively Chapter 5 details the reaction kinetics of detonating energetic materials Chapter 6 investigates the interplay between static and dynamic shock studies Finally Chapters 7 and 8 introduce numerical simulations molecular dynamics of energetic materials under either hydrostatic or uni axial stress and ab initio treatments of defects in crystalline materials This timely volume meets the growing demand for a state of the art introduction and review of the most relevant aspects of static compression of energetic materials and will be a valuable reference to researchers and scientists working in academic industrial and governmental research laboratories

Shock Waves Tai-Ping Liu, 2021-10-12 This book presents the fundamentals of the shock wave theory The first part of the book Chapters 1 through 5 covers the basic elements of the shock wave theory by analyzing the scalar conservation laws The main focus of the analysis is on the explicit solution behavior This first part of the book requires only a course in multi variable calculus and can be used as a text for an undergraduate topics course In the second part of the book Chapters 6 through 9 this general theory is used to study systems of hyperbolic conservation laws This is a most significant well posedness theory for weak solutions of quasilinear evolutionary partial differential equations The final part of the book Chapters 10 through 14 returns to the original subject of the shock wave theory by focusing on specific physical models Potentially interesting questions and research directions are also raised in these chapters The book can serve as an introductory text for advanced undergraduate students and for graduate students in mathematics engineering and physical sciences Each chapter ends with suggestions for further reading and exercises for students

Shock Wave Dynamics George Emanuel, 2012-12-18 Working knowledge of the relations of various quantities and their derivatives across a shock wave is useful for any advanced research involving shock waves Although these relations can be derived in principle by any diligent student of the subject the derivations are often not trivial and once derived neither the approach nor the result can be

Shock Wave Compression of Condensed Matter Jerry W Forbes, 2013-02-01 This book introduces the core concepts of the shock wave physics of condensed matter taking a continuum mechanics approach to examine liquids and isotropic solids The text primarily focuses on one dimensional uniaxial compression in order to show the key features of condensed matter's response to shock wave loading The first four chapters are specifically designed to quickly familiarize physical scientists and engineers with how shock waves interact with other shock waves or material boundaries as well as to allow readers to better understand shock wave literature use basic data analysis techniques and design simple 1 D shock wave experiments This is achieved by first presenting the steady one dimensional strain

conservation laws using shock wave impedance matching which insures conservation of mass momentum and energy Here the initial emphasis is on the meaning of shock wave and mass velocities in a laboratory coordinate system An overview of basic experimental techniques for measuring pressure shock velocity mass velocity compression and internal energy of steady 1 D shock waves is then presented In the second part of the book more advanced topics are progressively introduced thermodynamic surfaces are used to describe equilibrium flow behavior first order Maxwell solid models are used to describe time dependent flow behavior descriptions of detonation shock waves in ideal and non ideal explosives are provided and lastly a select group of current issues in shock wave physics are discussed in the final chapter

Medical and Biomedical Applications of Shock Waves Achim M. Loske, 2016-12-01 This book provides current comprehensive and clear explanations of the physics behind medical and biomedical applications of shock waves Extracorporeal shock wave lithotripsy is one of the greatest medical advances of our time and its techniques and clinical devices are continuously evolving Further research continues to improve the understanding of calculi fragmentation and tissue damaging mechanisms Shock waves are also used in orthopedics and traumatology Possible applications in oncology cardiology dentistry gene therapy cell transfection transformation of fungi and bacteria as well as the inactivation of microorganisms are promising approaches for clinical treatment industrial applications and research Medical and Biomedical Applications of Shock Waves is useful as a guide for students technicians and researchers working in universities and laboratories Chemists biologists physicians and veterinarians involved in research or clinical practice will find useful advice but also engineers and physicists may benefit from the overview of current research endeavors and future directions Furthermore it may also serve to direct manufacturers towards the design of more efficient and safer clinical industrial and laboratory equipment

Shock Waves Zonglin Jiang, 2010-05-30 The 24th International Symposium on Shock Waves ISSW24 was held at the Beijing Friendship Hotel during July 11 16 2004 in Beijing It was a great pleasure for the Local Organizing Committee to organize the ISSW in China for the first time because forty seven years have passed since the First Shock Tube Symposium was held in 1957 at Albuquerque The ISSW24 had to be postponed for one year because of the SARS outbreak in Beijing shortly before the Symposium was scheduled to be held in 2003 but it has achieved success due to the continuous support and kind understanding from all the delegates It is very heart warming to have had such an experience and I am very happy to have served as chairman for the Symposium I would like to thank all for the contributions and help that they have given us over the past three years without which we would not have had the Symposium A total of 460 abstracts were submitted to the ISSW24 Each of the abstracts was evaluated by three members of the Scientific Review Committee and the decision on acceptance was made based on the reviewers reports 195 oral papers including 9 plenary lectures were accepted to be presented in three parallel sessions and 135 poster papers in three dedicated poster sessions Topics discussed in these papers cover all aspects of shock wave research

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