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Similar Solutions for the Compressible Boundary Layer on a Yawed Cylinder with Transpiration Cooling *Numerical Analysis of Compressible Fluid Flows Stochastically Forced Compressible Fluid Flows Convex Integration Applied to the Multi-Dimensional Compressible Euler Equations* **The Solution of Compressible Laminar Boundary Layer Problems by a Finite Difference Method Introduction to Compressible Fluid Flow, Second Edition, 2nd Edition** *General Solution of the Laminar Compressible Boundary Layer in the Stagnation Region of Blunt Bodies in Axisymmetric Flow* **Numerical Solutions of the Compressible Boundary Layer Equations for Rotating Axisymmetric Flows** *Stabilization of Weak Solutions of Compressible Navier-Stokes Equations for Isothermal Fluids with a Nonlinear Stress Tensor* **Error Estimates for Cell-vertex Solutions of the Compressible Euler Equations** Mathematical and Computational Methods for Compressible Flow Compressible Fluid Flow and Systems of Conservation Laws in Several Space Variables **Existence of Solutions to the Navier-Stokes Equations for Steady Compressible Flow** *Numerical Solution of the Equations for Compressible Laminar, Transitional, and Turbulent Boundary Layers and Comparisons with Experimental Data* **On the Flow of a Compressible Fluid by the Hodograph Method Weak and Measure-Valued Solutions to Evolutionary PDEs On the Second-order Tunnel-wall-constriction Corrections in Two-dimensional Compressible Flow On Stationary Solutions for 2-D Viscous Compressible Isothermal Navier-Stokes Equations Compressible Turbulent Boundary Layers** Analysis of Weakly Compressible Turbulence Using Symmetry Methods and Direct Numerical Simulation **The Error in Gas Drive Calculations Caused by Ignoring Compressibility and Solution Effects** *NASA Technical Note* **Stationary solutions of the Navier-Stokes equations for a compressible, viscous and heat-conductive fluid Introduction to Compressible Fluid Flow, Second Edition** Numerical solutions to compressible flows in a nozzle with variable cross-section Measure valued solutions of the Euler and Navier-Stokes equations for compressible barotropic fluids Discontinuous Galerkin Method Waves and Compressible Flow *Thermally Stratified Compressible Fluid Motion on a Rotating Sphere with Gravitation* **Non-Ideal Compressible Fluid Dynamics for Propulsion and Power** *Measure valued solutions of the Euler equations for ideal compressible polytropic fluids Mathematical Theory of Compressible Viscous Fluids Introduction to Compressible Fluid Flow, Second Edition* **The Compressible Laminar Boundary Layer with Fluid Injection Discontinuous Galerkin Methods Topics on Compressible Navier-Stokes Equations** *Two-dimensional Compressible Flow in Centrifugal Compressors with Straight Blades* **Exact Solutions to the Riemann Problem for Compressible Isothermal Euler Equations for Two Phase Flows with and Without Phase Transitions 32nd Aerospace Sciences Meeting & Exhibit: 94-0569 - 94-0609 Compressible Fluid Flow**

Measure valued solutions of the Euler equations for ideal compressible polytropic fluids Apr 04 2020

On Stationary Solutions for 2-D Viscous Compressible Isothermal Navier-Stokes Equations May 18 2021

32nd Aerospace Sciences Meeting & Exhibit: 94-0569 - 94-0609 Jul 28 2019

Compressible Turbulent Boundary Layers Apr 16 2021

The Error in Gas Drive Calculations Caused by Ignoring Compressibility and Solution Effects Feb 12 2021

Thermally Stratified Compressible Fluid Motion on a Rotating Sphere with Gravitation Jun 06 2020 The problem of a thermally stratified compressible fluid on a rotating sphere with gravitation is discussed. An exact solution to the nonlinear Euler equations pertaining to this problem, which was recently obtained by H. E. Moses, is physically explained. The work represents a contribution toward a theoretical understanding of the motions and forces in the atmosphere, the environment in which the Air Force operates. (Modified author abstract)

Convex Integration Applied to the Multi-Dimensional Compressible Euler Equations Aug 01 2022 This book applies the convex integration method to multi-dimensional compressible Euler equations in the barotropic case as well as the full system with temperature. The convex integration technique, originally developed in the context of differential inclusions, was applied in the groundbreaking work of De Lellis and Sz é kelyhidi to the incompressible Euler equations, leading to infinitely many solutions. This theory was later refined to prove non-uniqueness of solutions of the compressible Euler system, too. These non-uniqueness results all use an ansatz which reduces the equations to a kind of incompressible system to which a slight modification of the incompressible theory can be applied. This book presents, for the first time, a generalization of the De Lellis – Sz é kelyhidi approach to the setting of compressible Euler equations. The structure of this book is as follows: after providing an accessible introduction to the subject, including the essentials of hyperbolic conservation laws, the idea of convex integration in the compressible framework is developed. The main result proves that under a certain assumption there exist infinitely many solutions to an abstract initial boundary value problem for the Euler system. Next some applications of this theorem are discussed, in particular concerning the Riemann problem. Finally there is a survey of some related results. This

self-contained book is suitable for both beginners in the field of hyperbolic conservation laws as well as for advanced readers who already know about convex integration in the incompressible framework.

Waves and Compressible Flow Jul 08 2020 This book covers compressible flow however the authors also show how wave phenomena in electromagnetism and solid mechanics can be treated using similar mathematical methods. It caters to the needs of the modern student by providing the tools necessary for a mathematical analysis of most kinds of waves liable to be encountered in modern science and technology. At the same time emphasis is laid on the physical background and modeling that requires these tools.

Analysis of Weakly Compressible Turbulence Using Symmetry Methods and Direct Numerical Simulation Mar 16 2021

Exact Solutions to the Riemann Problem for Compressible Isothermal Euler Equations for Two Phase Flows with and Without Phase Transitions Aug 28 2019

Measure valued solutions of the Euler and Navier-Stokes equations for compressible barotropic fluids Sep 09 2020

Stochastically Forced Compressible Fluid Flows Sep 02 2022 This book contains a first systematic study of compressible fluid flows subject to stochastic forcing. The bulk is the existence of dissipative martingale solutions to the stochastic compressible Navier-Stokes equations. These solutions are weak in the probabilistic sense as well as in the analytical sense. Moreover, the evolution of the energy can be controlled in terms of the initial energy. We analyze the behavior of solutions in short-time (where unique smooth solutions exists) as well as in the long term (existence of stationary solutions). Finally, we investigate the asymptotics with respect to several parameters of the model based on the energy inequality. Contents Part I: Preliminary results Elements of functional analysis Elements of stochastic analysis Part II: Existence theory Modeling fluid motion subject to random effects Global existence Local well-posedness Relative energy inequality and weak – strong uniqueness Part III: Applications Stationary solutions Singular limits

Error Estimates for Cell-vertex Solutions of the Compressible Euler Equations Jan 26 2022

The Compressible Laminar Boundary Layer with Fluid Injection Jan 02 2020 A solution of the equations of the compressible laminar boundary layer including the effects of transpiration cooling is presented. The analysis applies to the flow over an isothermal porous plate with a velocity of fluid injection proportional to the reciprocal of the square root of the distance from the leading edge.

Stationary solutions of the Navier-Stokes equations for a compressible, viscous and heat-conductive fluid Dec 13 2020

Similar Solutions for the Compressible Boundary Layer on a Yawed Cylinder with Transpiration Cooling Nov 04 2022 Heat-transfer and skin-friction parameters obtained from exact solutions to the laminar compressible boundary-layer equations for infinite cylinders in yaw are presented. The effects of transpiration cooling, Prandtl number, pressure gradient, wall temperature, and viscosity relation were investigated. It is shown that as the Mach number is increased for a given large yaw angle the effects of pressure gradient become larger and the quantity of coolant required to maintain a given wall temperature is also increased. The use of a linear viscosity-temperature relation gives approximately the same results as the Sutherland viscosity-temperature relation except for very high aerodynamic heating rates.

Discontinuous Galerkin Methods Dec 01 2019 A class of finite element methods, the Discontinuous Galerkin Methods (DGM), has been under rapid development recently and has found its use very quickly in such diverse applications as aeroacoustics, semi-conductor device simula tion, turbomachinery, turbulent flows, materials processing, MHD and plasma simulations, and image processing. While there has been a lot of interest from mathematicians, physicists and engineers in DGM, only scattered information is available and there has been no prior effort in organizing and publishing the existing volume of knowledge on this subject. In May 24-26, 1999 we organized in Newport (Rhode Island, USA), the first international symposium on DGM with equal emphasis on the theory, numerical implementation, and applications. Eighteen invited speakers, lead ers in the field, and thirty-two contributors presented various aspects and addressed open issues on DGM. In this volume we include forty-nine papers presented in the Symposium as well as a survey paper written by the organiz ers. All papers were peer-reviewed. A summary of these papers is included in the survey paper, which also provides a historical perspective of the evolution of DGM and its relation to other numerical methods. We hope this volume will become a major reference in this topic. It is intended for students and researchers who work in theory and application of numerical solution of convection dominated partial differential equations. The papers were written with the assumption that the reader has some knowledge of classical finite elements and finite volume methods.

Mathematical Theory of Compressible Viscous Fluids Mar 04 2020 This book offers an essential introduction to the mathematical theory of compressible viscous fluids. The main goal is to present analytical methods from the perspective of their numerical applications. Accordingly, we introduce the principal theoretical tools needed to handle well-posedness of the underlying Navier-Stokes system, study the problems of sequential stability, and, lastly, construct solutions by means of an implicit numerical scheme. Offering a unique contribution – by exploring in detail the " synergy " of analytical and numerical methods – the book offers a valuable resource for graduate students in mathematics and researchers working in mathematical fluid mechanics. Mathematical fluid mechanics concerns problems that are closely connected to real-world applications and is also an important part of the theory of partial differential equations and numerical analysis in general.

This book highlights the fact that numerical and mathematical analysis are not two separate fields of mathematics. It will help graduate students and researchers to not only better understand problems in mathematical compressible fluid mechanics but also to learn something from the field of mathematical and numerical analysis and to see the connections between the two worlds. Potential readers should possess a good command of the basic tools of functional analysis and partial differential equations including the function spaces of Sobolev type.

Weak and Measure-Valued Solutions to Evolutionary PDEs Jul 20 2021 This book provides a concise treatment of the theory of nonlinear evolutionary partial differential equations. It provides a rigorous analysis of non-Newtonian fluids, and outlines its results for applications in physics, biology, and mechanical engineering

Compressible Fluid Flow Jun 26 2019 This reference develops the fundamental concepts of compressible fluid flow by clearly illustrating their applications in real-world practice through the use of numerous worked-out examples and problems. The book covers concepts of thermodynamics and fluid mechanics which relate directly to compressible flow; discusses isentropic flow through a variable-area duct; describes normal shock waves, including moving shock waves and shock-tube analysis; explores the effects of friction and heat interaction on the flow of a compressible fluid; covers two-dimensional shock and expansion waves; provides a treatment of linearized flow; discusses unsteady wave propagation and computational methods in fluid dynamics; provides several numerical methods for solving linear and nonlinear equations encountered in compressible flow; offers modern computational methods for solving nonintegrable equations; and describes methods of measurement in high-speed flow. Suitable for the practicing engineer engaged in compressible-flow applications.

General Solution of the Laminar Compressible Boundary Layer in the Stagnation Region of Blunt Bodies in Axisymmetric Flow Apr 28 2022

Existence of Solutions to the Navier-Stokes Equations for Steady Compressible Flow Oct 23 2021

Compressible Fluid Flow and Systems of Conservation Laws in Several Space Variables Nov 23 2021 Conservation laws arise from the modeling of physical processes through the following three steps: 1) The appropriate physical balance laws are derived for m-phy- t cal quantities, ul""~ with u = (ul' ... ,u) and u(x,t) defined m for x = (xl""~) E RN (N = 1,2, or 3), t > 0 and with the values m u(x,t) lying in an open subset, G, of R , the state space. The state space G arises because physical quantities such as the density or total energy should always be positive; thus the values of u are often con strained to an open set G. 2) The flux functions appearing in these balance laws are idealized through prescribed nonlinear functions, F.(u), mapping G into J j = 1, .. · ,N while source terms are defined by S(u,x,t) with S a given smooth function of these arguments with values in Rm. In parti- lar, the detailed microscopic effects of diffusion and dissipation are ignored. 3) A generalized version of the principle of virtual work is applied (see Antman [1]). The formal result of applying the three steps (1)-(3) is that the m physical quantities u define a weak solution of an m x m system of conservation laws, o I + N(Wt'u + r W · F.(u) + W · S(u,x,t))dxdt (1.1) R xR j=l Xj J for all W E C~(RN x R+), W(x,t) E Rm.

Discontinuous Galerkin Method Aug 09 2020 The subject of the book is the mathematical theory of the discontinuous Galerkin method (DGM), which is a relatively new technique for the numerical solution of partial differential equations. The book is concerned with the DGM developed for elliptic and parabolic equations and its applications to the numerical simulation of compressible flow. It deals with the theoretical as well as practical aspects of the DGM and treats the basic concepts and ideas of the DGM, as well as the latest significant findings and achievements in this area. The main benefit for readers and the book ' s uniqueness lie in the fact that it is sufficiently detailed, extensive and mathematically precise, while at the same time providing a comprehensible guide through a wide spectrum of discontinuous Galerkin techniques and a survey of the latest efficient, accurate and robust discontinuous Galerkin schemes for the solution of compressible flow.

Numerical solutions to compressible flows in a nozzle with variable cross-section Oct 11 2020

Numerical Solutions of the Compressible Boundary Layer Equations for Rotating Axisymmetric Flows Mar 28 2022

The Solution of Compressible Laminar Boundary Layer Problems by a Finite Difference Method Jun 30 2022

Topics on Compressible Navier-Stokes Equations Oct 30 2019

On the Flow of a Compressible Fluid by the Hodograph Method Aug 21 2021 A brief review of general conditions limiting the potential flow of an adiabatic compressible fluid is given and application is made to the particular solutions, yielding conditions for the existence of singular loci in the supersonic range.

Numerical Analysis of Compressible Fluid Flows Oct 03 2022 This book is devoted to the numerical analysis of compressible fluids in the spirit of the celebrated Lax equivalence theorem. The text is aimed at graduate students in mathematics and fluid dynamics, researchers in applied mathematics, numerical analysis and scientific computing, and engineers and physicists. The book contains original theoretical material based on a new approach to generalized solutions (dissipative or measure-valued solutions). The concept of a weak-strong uniqueness principle in the class of generalized solutions is used to prove the convergence of various numerical methods. The problem of oscillatory solutions is solved by an original adaptation of the method of K-convergence. An effective method of computing the Young measures is presented. Theoretical results are illustrated by a series of numerical experiments. Applications of these concepts are to be expected in other problems of fluid mechanics and related fields.

Introduction to Compressible Fluid Flow, Second Edition Nov 11 2020 Introduction to Compressible Fluid Flow, Second Edition offers extensive coverage of the physical phenomena experienced in compressible flow. Updated and revised, the second edition provides a thorough explanation of the assumptions used in the analysis of compressible flows. It develops in students an understanding of what causes compressible flows to differ from incompressible flows and how they can be analyzed. This book also offers a strong foundation for more advanced and focused study. The book begins with discussions of the analysis of isentropic flows, of normal and oblique shock waves and of expansion waves. The final chapters deal with nozzle characteristics, friction effects, heat exchange effects, a hypersonic flow, high-temperature gas effects, and low-density flows. This book applies real-world applications and gives greater attention to the supporting software and its practical application. Includes numerical results obtained using a modern commercial CFD (computer fluid dynamics) code to illustrate the type of results that can be obtained using such a code Replaces BASIC language programs with MATLAB ® routines Avails COMPROP2 software which readers can use to do compressible flow computation Additional problems have been added, and non-numerical problems illustrating practical applications have been included. A solutions manual that contains complete solutions to all of the problems in this book is available. The manual incorporates the same problem-solving methodology as adopted in the worked examples in this book. It also provides summaries of the major equations developed in each chapter. An interactive computer program also accompanies this book.

Numerical Solution of the Equations for Compressible Laminar, Transitional, and Turbulent Boundary Layers and Comparisons with Experimental Data Sep 21 2021 A numerical method for solving the equations for laminar, transitional, and turbulent compressible boundary layers for either planar or axisymmetric flows is presented. The fully developed turbulent region is treated by replacing the Reynolds stress terms with an eddy viscosity model. The mean properties of the transitional boundary layer are calculated by multiplying the eddy viscosity by an intermittency function based on the statistical production and growth of the turbulent spots. A specifiable turbulent Prandtl number relates the turbulent flux of heat to the eddy viscosity. A three-point implicit finite-difference scheme is used to solve the system of equations. The momentum and energy equations are solved simultaneously without iteration. Numerous test cases are compared with experimental data for supersonic and hypersonic flows; these cases include flows with both favorable and mildly unfavorable pressure gradient histories, mass flux at the wall, and traverse curvature.

Introduction to Compressible Fluid Flow, Second Edition, 2nd Edition May 30 2022 Introduction to Compressible Fluid Flow, Second Edition offers extensive coverage of the physical phenomena experienced in compressible flow. Updated and revised, the second edition provides a thorough explanation of the assumptions used in the analysis of compressible flows. It develops in students an understanding of what causes compressible flows to differ from incompressible flows and how they can be analyzed. This book also offers a strong foundation for more advanced and focused study. The book begins with discussions of the analysis of isentropic flows, of normal and oblique shock waves and of expansion waves. The final chapters deal with nozzle characteristics, friction effects, heat exchange effects, a hypersonic flow, high-temperature gas effects, and low-density flows. This book applies real-world applications and gives greater attention to the supporting software and its practical application. Includes numerical results obtained using a modern commercial CFD (computer fluid dynamics) code to illustrate the type of results that can be obtained using such a code Replaces BASIC language programs with MATLAB ® routines Avails COMPROP2 software which readers can use to do compressible flow computation Additional problems have been added, and non-numerical problems illustrating practical applications have been included. A solutions manual that contains complete solutions to all of the problems in this book is available. The manual incorporates the same problem-solving methodology as adopted in the worked examples in this book. It also provides summaries of the major equations developed in each chapter. An interactive computer program also accompanies this book.

Non-Ideal Compressible Fluid Dynamics for Propulsion and Power May 06 2020 This book reports on advanced theories and methods aimed at characterizing the dynamics of non-ideal compressible fluids. A special emphasis is given to research fostering the use of non-ideal compressible fluids for propulsion and power engineering. Both numerical and experimental studies, as well as simulations, are described in the book, which is based on selected contributions and keynote lectures presented at the 2nd International Seminar on Non-Ideal Compressible-Fluid Dynamics for Propulsion & Power. Held on October 4-5 in Bochum, Germany, the seminar aimed at fostering collaborations between academics and professionals. The two perspectives have been gathered together in this book, which offers a timely guide to advanced fundamentals, innovative methods and current applications of non-ideal compressible fluids to developing turbomachines, and for propulsion and power generation.

Stabilization of Weak Solutions of Compressible Navier-Stokes Equations for Isothermal Fluids with a Nonlinear Stress Tensor Feb 24 2022

Mathematical and Computational Methods for Compressible Flow Dec 25 2021 This book is concerned with mathematical and numerical methods for compressible flow. It aims to provide the reader with a sufficiently detailed and extensive, mathematically precise, but comprehensible guide, through a wide spectrum of mathematical and computational methods used in Computational Fluid Dynamics (CFD) for the numerical simulation of compressible flow. Up-to-date

techniques applied in the numerical solution of inviscid as well as viscous compressible flow on unstructured meshes are explained, thus allowing the simulation of complex three-dimensional technically relevant problems. Among some of the methods addressed are finite volume methods using approximate Riemann solvers, finite element techniques, such as the streamline diffusion and the discontinuous Galerkin methods, and combined finite volume - finite element schemes. The book gives a complex insight into the numerics of compressible flow, covering the development of numerical schemes and their theoretical mathematical analysis, their verification on test problems and use in solving practical engineering problems. The book will be helpful to specialists coming into contact with CFD - pure and applied mathematicians, aerodynamists, engineers, physicists and natural scientists. It will also be suitable for advanced undergraduate, graduate and postgraduate students of mathematics and technical sciences.

On the Second-order Tunnel-wall-constriction Corrections in Two-dimensional Compressible Flow Jun 18 2021 Solutions of the first- and second-order Prandtl-Busemann iteration equations are obtained for the flow past thin, sharp-nose, symmetric, two-dimensional bodies in closed channels. With the use of these solutions an expression is derived for the tunnel-wall interference. The tunnel-wall correction for a parabolic-arc airfoil is calculated to indicate the effects of compressibility, ratio of the tunnel height to the airfoil chord, and airfoil thickness coefficient. It appears that, for cases where the tunnel-wall corrections are significant, both the second-order effects and the variation of the correction along the chord should be considered.

NASA Technical Note Jan 14 2021

Introduction to Compressible Fluid Flow, Second Edition Feb 01 2020 Introduction to Compressible Fluid Flow, Second Edition offers extensive coverage of the physical phenomena experienced in compressible flow. Updated and revised, the second edition provides a thorough explanation of the assumptions used in the analysis of compressible flows. It develops in students an understanding of what causes compressible flows to differ from incompressible flows and how they can be analyzed. This book also offers a strong foundation for more advanced and focused study. The book begins with discussions of the analysis of isentropic flows, of normal and oblique shock waves and of expansion waves. The final chapters deal with nozzle characteristics, friction effects, heat exchange effects, a hypersonic flow, high-temperature gas effects, and low-density flows. This book applies real-world applications and gives greater attention to the supporting software and its practical application. Includes numerical results obtained using a modern commercial CFD (computer fluid dynamics) code to illustrate the type of results that can be obtained using such a code Replaces BASIC language programs with MATLAB ® routines Avails COMPROP2 software which readers can use to do compressible flow computation Additional problems have been added, and non-numerical problems illustrating practical applications have been included. A solutions manual that contains complete solutions to all of the problems in this book is available. The manual incorporates the same problem-solving methodology as adopted in the worked examples in this book. It also provides summaries of the major equations developed in each chapter. An interactive computer program also accompanies this book.

Two-dimensional Compressible Flow in Centrifugal Compressors with Straight Blades Sep 29 2019 Six numerical examples are presented for steady, two-dimensional, compressible, nonviscous flow in centrifugal compressors with straight blades. A seventh example is presented for incompressible flow. The solutions also applye to radial-flow turbines with rotation and flow direction reversed. The effects of variations in following parameters were investigated: (1) flow rate, (2) impeller-tip speed, (3) variation of passage height with radius, and (4) number of blades. The numerical results are presented in plots of the streamlines, constant Mach number lines, and constant pressure-ratio lines. Correlation equations are developed whereby the flow conditions in any impeller with straight blades can be determined for all operating conditions.