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Uncertainty Management for Robust Industrial Design in Aeronautics - Charles Hirsch 2018-07-21
This book covers cutting-edge findings related to uncertainty quantification and optimization under uncertainties (i.e. robust and reliable optimization), with a special emphasis on aeronautics and turbomachinery, although not limited to these fields. It describes new methods for uncertainty quantification, such as non-intrusive polynomial chaos, collocation methods, perturbation methods, as well as adjoint based and multi-level Monte Carlo methods. It includes methods for characterization of most influential uncertainties, as well as formulations for robust and reliable design optimization. A distinctive element of the book is the unique collection of test cases with prescribed uncertainties, which are representative of the current engineering practice of the industrial consortium partners involved in UMRIDA, a level 1 collaborative project within the European Commission's Seventh Framework Programme (FP7). All developed methods are benchmarked against these industrial challenges. Moreover, the book includes a section dedicated to Best Practice Guidelines for uncertainty quantification and robust design optimization, summarizing the findings obtained by the consortium members within the UMRIDA project. All in all, the book offers a authoritative guide to cutting-edge methodologies for uncertainty management in engineering design, covers a wide range of applications and discusses new ideas for future research and interdisciplinary collaborations.
Turbulent Combustion Modeling - Tarek Echekki 2010-12-25
Turbulent combustion sits at the interface of two important nonlinear, multiscale phenomena: chemistry and turbulence. Its study is extremely timely in view of the need to develop new combustion technologies in order to address challenges associated with climate change, energy source uncertainty, and air pollution. Despite the fact that modeling of turbulent combustion is a subject that has been researched for a number of years, its complexity implies that key issues are still eluding, and a theoretical description that is accurate enough to make turbulent combustion models rigorous and quantitative for industrial use is still lacking. In this book, prominent experts review most of the available approaches in modeling turbulent combustion, with particular focus on the exploding increase in computational resources that has allowed the simulation of increasingly detailed phenomena. The relevant algorithms are presented, the theoretical methods are explained, and various application examples are given. The book is intended for a relatively broad audience, including seasoned researchers and graduate students in engineering, applied mathematics and computational science, engine designers and computational fluid dynamics (CFD) practitioners, scientists at funding agencies, and anyone wishing to understand the state-of-the-art and the future directions of this scientifically challenging and practically important field.
Shock Fitting - Marcello Onofri 2017-11-18
This book describes the revolutionary capabilities of new shock fitting algorithms; a great improvement in computational fluid dynamics (CFD) for high-speed numerical simulations. Shock fitting methods provide a solution to the current difficulties and inaccuracies in shock-capturing approaches. This work traces the evolution of shock-fitting methods, from the pioneering methods based on the structured grids (boundary and floating shock-fitting) to recent developments on unstructured grids, illustrating algorithmic details, significant applications and potential developments. Also, to celebrate the centenary birth of the father of shock-fitting techniques, the book also includes a tribute to Gino Moretti, as well as his unpublished manuscript. This book will appeal to professionals, researchers, and graduate students in the field of CFD.
Large-Eddy Simulation for Acoustics - Claus Wagner 2007-01-15
Noise pollution around airports, trains, and industries increasingly attracts environmental concern and regulation. Designers and researchers have intensified the use of large-eddy simulation (LES) for noise reduced industrial design and acoustical research. This 2007 book, written by 30 experts, presents the theoretical background of acoustics and of LES, followed by details about numerical methods, e.g. discretization schemes, boundary conditions, coupling aspects. Industrially relevant, hybrid RANS/LES techniques for acoustic source predictions are presented in detail. Many applications are featured ranging from simple geometries for mixing layers and jet flows to complex wing and car geometries. Selected applications include scientific investigations at industrial and university research institutions.
Catalytic Reactors - Basudeb Saha 2016-01-01
Reactor design for Chemical Engineering deals with maximization of product yields and the net present value for the chemical reaction, optimization of the reaction efficiency, and minimization of costs. This book discusses the best choice of catalysts, different reaction steps and intermediates and the design of the catalytic reactors, in which the catalysis and chemical reaction are combined to achieve intensification.
Principles of Combustion - Kenneth K. Kuo 1986-05-08
This comprehensive text covers principles and applications with an emphasis on the theoretical modeling of combustion. Addresses chemical thermodynamics and kinetics, conservation equations for multi-component reacting flows, deflagration and detonation waves, premixed laminar flames, spray combustion of fuel droplets, ignition, and related topics. Many examples are included to demonstrate the application of theory. Emphasizes the use of digital computers for solutions.
Biomass as a Sustainable Energy Source for the Future - Wiebren de Jong 2014-11-03
Focusing on the conversion of biomass into gas or liquid fuels the book covers physical pre-treatment technologies, thermal, chemical and biochemical conversion technologies • Details the latest biomass characterization techniques • Explains the biochemical and thermochemical conversion processes • Discusses the development of integrated biorefineries, which are similar to petroleum refineries in concept, covering such topics as reactor configurations and downstream processing • Describes how to mitigate the environmental risks when using biomass as fuel • Includes many problems, small projects, sample calculations and industrial application examples
Assessment of Intraseasonal to Interannual Climate Prediction and Predictability - National Research Council 2010-09-08
More accurate forecasts of climate conditions over time periods of weeks to a few years could help people plan agricultural activities, mitigate drought, and manage energy resources, amongst other activities; however, current forecast systems have limited ability on these time-scales. Models for such climate forecasts must take into account complex interactions among the ocean, atmosphere, and land surface. Such processes can be difficult to represent realistically. To improve the quality of forecasts, this book makes recommendations about the development of the tools used in forecasting and about specific research goals for improving understanding of sources of predictability. To improve the accessibility of these forecasts to decision-makers and researchers, this book also suggests best practices to improve how forecasts are made and disseminated.
Quality and Reliability of Large-Eddy Simulations - Johan Meyers 2008-06-26
Computational resources have developed to the level that, for the first time, it is becoming possible to apply large-eddy simulation (LES) to turbulent flow problems of realistic complexity. Many examples can be found in technology and in a variety of natural flows. This puts issues

related to assessing, assuring, and predicting the quality of LES into the spotlight. Several LES studies have been published in the past, demonstrating a high level of accuracy with which turbulent flow predictions can be attained, without having to resort to the excessive requirements on computational resources imposed by direct numerical simulations. However, the setup and use of turbulent flow simulations requires a profound knowledge of fluid mechanics, numerical techniques, and the application under consideration. The susceptibility of large-eddy simulations to errors in modelling, in numerics, and in the treatment of boundary conditions, can be quite large due to nonlinear accumulation of different contributions over time, leading to an intricate and unpredictable situation. A full understanding of the interacting error dynamics in large-eddy simulations is still lacking. To ensure the reliability of large-eddy simulations for a wide range of industrial users, the development of clear standards for the evaluation, prediction, and control of simulation errors in LES is summoned. The workshop on Quality and Reliability of Large-Eddy Simulations, held October 22-24, 2007 in Leuven, Belgium (QLES2007), provided one of the first platforms specifically addressing these aspects of LES.

Numerical Computation of Internal and External Flows, Volume 2 - Charles Hirsch 1991-01-08

Numerical Computation of Internal and External Flows Volume 2: Computational Methods for Inviscid and Viscous Flows C. Hirsch, Vrije Universiteit Brussel, Brussels, Belgium This second volume deals with the applications of computational methods to the problems of fluid dynamics. It complements the first volume to provide an excellent reference source in this vital and fast growing area. The author includes material on the numerical computation of potential flows and on the most up-to-date methods for Euler and Navier-Stokes equations. The coverage is comprehensive and includes detailed discussion of numerical techniques and algorithms, including implementation topics such as boundary conditions. Problems are given at the end of each chapter and there are comprehensive reference lists. Of increasing interest, the subject has powerful implications in such crucial fields as aeronautics and industrial fluid dynamics. Striking a balance between theory and application, the combined volumes will be useful for an increasing number of courses, as well as to practitioners and researchers in computational fluid dynamics. Contents Preface Nomenclature Part V: The Numerical Computation of Potential Flows Chapter 13 The Mathematical Formulations of the Potential Flow Model Chapter 14 The Discretization of the Subsonic Potential Equation Chapter 15 The Computation of Stationary Transonic Potential Flows Part VI: The Numerical Solution of the System of Euler Equations Chapter 16 The Mathematical Formulation of the System of Euler Equations Chapter 17 The Lax - Wendroff Family of Space-centred Schemes Chapter 18 The Central Schemes with Independent Time Integration Chapter 19 The Treatment of Boundary Conditions Chapter 20 Upwind Schemes for the Euler Equations Chapter 21 Second-order Upwind and High-resolution Schemes Part VII: The Numerical Solution of the Navier-Stokes Equations Chapter 22 The Properties of the System of Navier-Stokes Equations Chapter 23 Discretization Methods for the Navier-Stokes Equations Index

High-Performance Computing of Big Data for Turbulence and Combustion - Sergio Pirozzoli 2020-08-14

This book provides state-of-art information on high-accuracy scientific computing and its future prospects, as applicable to the broad areas of fluid mechanics and combustion, and across all speed regimes. Beginning with the concepts of space-time discretization and dispersion relation in numerical computing, the foundations are laid for the efficient solution of the Navier-Stokes equations, with special reference to prominent approaches such as LES, DES and DNS. The basis of high-accuracy computing is rooted in the concept of stability, dispersion and phase errors, which require the comprehensive analysis of discrete computing by rigorously applying error dynamics. In this context, high-order finite-difference and finite-volume methods are presented. Naturally, the coverage also includes fundamental notions of high-performance computing and advanced concepts on parallel computing, including their implementation in prospective hexascale computers. Moreover, the book seeks to raise the bar beyond the pedagogical use of high-accuracy computing by addressing more complex physical scenarios, including turbulent combustion. Tools like proper orthogonal decomposition (POD), proper generalized decomposition (PGD), singular value decomposition (SVD), recursive POD, and high-order SVD in multi-parameter spaces are presented. Special attention is paid to bivariate and multivariate datasets in connection with various canonical flow and heat transfer cases. The book mainly addresses the needs of researchers and doctoral students in mechanical engineering, aerospace engineering, and all applied disciplines including applied mathematics, offering these readers a unique resource.

Applied Mechanics Reviews - 1997

Combustion Instabilities in Gas Turbine Engines - Timothy C. Lieuwen 2005

Higher operating efficiencies, fewer pollutant emissions, and low capital investment have made gas turbines a dominant technology for new power generating capacity in the U.S. and worldwide. This book offers gas turbine users and manufacturers a valuable resource to help them sort through issues associated with combustion instabilities. In the last ten years, substantial efforts have been made in the industrial, governmental, and academic communities to understand the unique issues associated with combustion instabilities in low-emission gas turbines. The objective of this book is to compile these results into a series of chapters that address the various facets of the problem. The Case Studies section speaks to specific manufacturer and user experiences with combustion instabilities in the development stage and in fielded turbine engines. The book then goes on to examine The Fundamental Mechanisms, The Combustor Modeling, and Control Approaches.

Combustion Noise - Anna Schwarz 2009-06-17

November, 2008 Anna Schwarz, Johannes Janicka In the last thirty years noise emission has developed into a topic of increasing importance to society and economy. In ?elds such as air, road and rail traf?c, the control of noise emissions and development of associated noise-reduction techno- gies is a central requirement for social acceptance and economical competitiveness. The noise emission of combustion systems is a major part of the task of noise - duction. The following aspects motivate research: • Modern combustion chambers in technical combustion systems with low pol- tion exhausts are 5 - 8 dB louder compared to their predecessors. In the ope- tional state the noise pressure levels achieved can even be 10-15 dB louder. • High capacity torches in the chemical industry are usually placed at ground level because of the reasons of noise emissions instead of being placed at a height suitable for safety and security. • For airplanes the combustion emissions become a more and more important topic. The combustion instability and noise issues are one major obstacle for the introduction of green technologies as lean fuel combustion and premixed burners in aero-engines. The direct and indirect contribution of combustion noise to the overall core noise is still under discussion. However, it is clear that the core noise besides the fan tone will become an important noise source in future aero-engine designs. To further reduce the jet noise, geared ultra high bypass ratio fans are driven by only a few highly loaded turbine stages.

Turbulent Reactive Flows - R. Borghi 2013-03-08

Turbulent reactive flows are of common occurrance in combustion engineering, chemical reactor technology and various types of engines producing power and thrust utilizing chemical and nuclear fuels. Pollutant formation and dispersion in the atmospheric environment and in rivers, lakes and ocean also involve interactions between turbulence, chemical reactivity and heat and mass transfer processes. Considerable advances have occurred over the past twenty years in the understanding, analysis, measurement, prediction and control of turbulent reactive flows. Two main contributors to such advances are improvements in instrumentation and spectacular growth in computation: hardware, sciences and skills and data processing software, each leading to developments in others. Turbulence presents several features that are situation-specific. Both for that reason and a number of others, it is yet difficult to visualize a so-called solution of the turbulence problem or even a generalized approach to the problem. It appears that recognition of patterns and structures in turbulent flow and their study based on considerations of stability, interactions, chaos and fractal character may be opening up an avenue of research that may be leading to a generalized approach to classification and analysis and, possibly, prediction of specific processes in the flowfield. Predictions for engineering use, on the other hand, can be foreseen for sometime to come to depend upon modeling of selected features of turbulence at various levels of sophistication dictated by perceived need and available capability.

Computational Fluid Mechanics and Heat Transfer - Dale Anderson 2020-12-18

Computational Fluid Mechanics and Heat Transfer, Fourth Edition is a

fully updated version of the classic text on finite-difference and finite-volume computational methods. Divided into two parts, the text covers essential concepts, and then moves on to fluids equations in the second part. Designed as a valuable resource for practitioners and students, new examples and homework problems have been added to further enhance the student's understanding of the fundamentals and applications. Provides a thoroughly updated presentation of CFD and computational heat transfer Covers more material than other texts, organized for classroom instruction and self-study Presents a range of flow computation strategies and extensive computational heat transfer coverage Includes more extensive coverage of computational heat transfer methods Features a full Solutions Manual and Figure Slides for classroom projection Written as an introductory text for advanced undergraduates and first-year graduate students, the new edition provides the background necessary for solving complex problems in fluid mechanics and heat transfer.

Using HPC for Computational Fluid Dynamics - Shamoon Jamshed 2015-05-12

Using HPC for Computational Fluid Dynamics: A Guide to High Performance Computing for CFD Engineers offers one of the first self-contained guides on the use of high performance computing for computational work in fluid dynamics. Beginning with an introduction to HPC, including its history and basic terminology, the book moves on to consider how modern supercomputers can be used to solve common CFD challenges, including the resolution of high density grids and dealing with the large file sizes generated when using commercial codes. Written to help early career engineers and post-graduate students compete in the fast-paced computational field where knowledge of CFD alone is no longer sufficient, the text provides a one-stop resource for all the technical information readers will need for successful HPC computation. Offers one of the first self-contained guides on the use of high performance computing for computational work in fluid dynamics Tailored to the needs of engineers seeking to run CFD computations in a HPC environment

Unsteady Computational Fluid Dynamics in Aeronautics - P.G. Tucker 2013-08-30

The field of Large Eddy Simulation (LES) and hybrids is a vibrant research area. This book runs through all the potential unsteady modelling fidelity ranges, from low-order to LES. The latter is probably the highest fidelity for practical aerospace systems modelling. Cutting edge new frontiers are defined. One example of a pressing environmental concern is noise. For the accurate prediction of this, unsteady modelling is needed. Hence computational aeroacoustics is explored. It is also emerging that there is a critical need for coupled simulations. Hence, this area is also considered and the tensions of utilizing such simulations with the already expensive LES. This work has relevance to the general field of CFD and LES and to a wide variety of non-aerospace aerodynamic systems (e.g. cars, submarines, ships, electronics, buildings). Topics treated include unsteady flow techniques; LES and hybrids; general numerical methods; computational aeroacoustics; computational aeroelasticity; coupled simulations and turbulence and its modelling (LES, RANS, transition, VLES, URANS). The volume concludes by pointing forward to future horizons and in particular the industrial use of LES. The writing style is accessible and useful to both academics and industrial practitioners. From the reviews: "Tucker's volume provides a very welcome, concise discussion of current capabilities for simulating and modellng unsteady aerodynamic flows. It covers the various pos sible numerical techniques in good, clear detail and presents a very wide range of practical applications; beautifully illustrated in many cases. This book thus provides a valuable text for practicing engineers, a rich source of background information for students and those new to this area of Research & Development, and an excellent state-of-the-art review for others. A great achievement." Mark Savill FHEA, FRAeS, C.Eng, Professor of Computational Aerodynamics Design & Head of Power & Propulsion Sciences, Department of Power & Propulsion, School of Engineering, Cranfield University, Bedfordshire, U.K. "This is a very useful book with a wide coverage of many aspects in unsteady aerodynamics method development and applications for internal and external flows." L. He, Rolls-Royce/RAEng Chair of Computational Aerothermal Engineering, Oxford University, U.K. "This comprehensive book ranges from classical concepts in both numerical methods and turbulence modelling approaches for the beginner to latest state-of-the-art for the advanced practitioner and constitutes an extremely valuable contribution to the specific Computational Fluid Dynamics literature in Aeronautics. Student and expert alike will benefit greatly by reading it from cover to cover." Sébastien Deck, Onera, Meudon, France

The Hybrid High-Order Method for Polytopal Meshes - Daniele Antonio Di Pietro 2020-04-03

This monograph provides an introduction to the design and analysis of Hybrid High-Order methods for diffusive problems, along with a panel of applications to advanced models in computational mechanics. Hybrid High-Order methods are new-generation numerical methods for partial differential equations with features that set them apart from traditional ones. These include: the support of polytopal meshes, including non-star-shaped elements and hanging nodes; the possibility of having arbitrary approximation orders in any space dimension; an enhanced compliance with the physics; and a reduced computational cost thanks to compact stencil and static condensation. The first part of the monograph lays the foundations of the method, considering linear scalar second-order models, including scalar diffusion – possibly heterogeneous and anisotropic – and diffusion-advection-reaction. The second part addresses applications to more complex models from the engineering sciences: non-linear Leray-Lions problems, elasticity, and incompressible fluid flows. This book is primarily intended for graduate students and researchers in applied mathematics and numerical analysis, who will find here valuable analysis tools of general scope.

Theoretical and Numerical Combustion - Thierry Poinsot 2005

Introducing numerical techniques for combustion, this textbook describes both laminar and turbulent flames, addresses the problem of flame-wall interaction, and presents a series of theoretical tools used to study the coupling phenomena between combustion and acoustics. The second edition incorporates recent advances in unsteady simulation methods,

Computational Fluid Dynamics: Principles and Applications - Jiri Blazek 2005-12-20

Computational Fluid Dynamics (CFD) is an important design tool in engineering and also a substantial research tool in various physical sciences as well as in biology. The objective of this book is to provide university students with a solid foundation for understanding the numerical methods employed in today's CFD and to familiarise them with modern CFD codes by hands-on experience. It is also intended for engineers and scientists starting to work in the field of CFD or for those who apply CFD codes. Due to the detailed index, the text can serve as a reference handbook too. Each chapter includes an extensive bibliography, which provides an excellent basis for further studies.

ADIGMA – A European Initiative on the Development of Adaptive Higher-Order Variational Methods for Aerospace Applications - Norbert Kroll 2010-09-18

This volume contains results gained from the EU-funded 6th Framework project ADIGMA (Adaptive Higher-order Variational Methods for Aerodynamic Applications in Industry). The goal of ADIGMA was the development and utilization of innovative adaptive higher-order methods for the compressible flow equations enabling reliable, mesh independent numerical solutions for large-scale aerodynamic applications in aircraft industry. The ADIGMA consortium was comprised of 22 organizations which included the main European aircraft manufacturers, the major European research establishments and several universities, all with well proven expertise in Computational Fluid Dynamics (CFD). The book presents an introduction to the project, exhibits partners' methods and approaches and provides a critical assessment of the newly developed methods for industrial aerodynamic applications. The best numerical strategies for integration as major building blocks for the next generation of industrial flow solvers are identified.

High Performance Computing and Communications - Michael Gerndt 2006-09-13

This book constitutes the refereed proceedings of the Second International Conference on High Performance Computing and Communications, HPCC 2006. The book presents 95 revised full papers, addressing all current issues of parallel and distributed systems and high performance computing and communication. Coverage includes networking protocols, routing, and algorithms, languages and compilers for HPC, parallel and distributed architectures and algorithms, wireless, mobile and pervasive computing, Web services, peer-to-peer computing, and more.

The Boundary Element Method in Acoustics - Stephen Kirkup 1998

Additive Runge-Kutta Schemes for Convection-diffusion-reaction Equations - Christopher Alan Kennedy 2001

Additive Runge-Kutta (ARK) methods are investigated for application to

the spatially discretized one-dimensional convection-diffusion-reaction (CDR) equations. First, accuracy, stability, conservation, and dense output are considered for the general case when N different Runge-Kutta methods are grouped into a single composite method. Then, implicit-explicit, N=2, additive Runge-Kutta ARK methods from third- to fifth-order are presented that allow for integration of stiff terms by an L-stable, stiffly-accurate explicit, singly diagonally implicit Runge-Kutta (ESDIRK) method while the nonstiff terms are integrated with a traditional explicit Runge-Kutta method (ERK). Coupling error terms are of equal order to those of the elemental methods. Derived ARK methods have vanishing stability functions for very large values of the stiff scaled eigenvalue and retain high stability efficiency in the absence of stiffness.

Cleaner Combustion - Frédérique Battin-Leclerc 2013-09-06

This overview compiles the on-going research in Europe to enlarge and deepen the understanding of the reaction mechanisms and pathways associated with the combustion of an increased range of fuels. Focus is given to the formation of a large number of hazardous minor pollutants and the inability of current combustion models to predict the formation of minor products such as alkenes, dienes, aromatics, aldehydes and soot nano-particles which have a deleterious impact on both the environment and on human health. Cleaner Combustion describes, at a fundamental level, the reactive chemistry of minor pollutants within extensively validated detailed mechanisms for traditional fuels, but also innovative surrogates, describing the complex chemistry of new environmentally important bio-fuels. Divided into five sections, a broad yet detailed coverage of related research is provided. Beginning with the development of detailed kinetic mechanisms, chapters go on to explore techniques to obtain reliable experimental data, soot and polycyclic aromatic hydrocarbons, mechanism reduction and uncertainty analysis, and elementary reactions. This comprehensive coverage of current research provides a solid foundation for researchers, managers, policy makers and industry operators working in or developing this innovative and globally relevant field.

Tools for High Performance Computing 2017 - Christoph Niethammer 2019-02-14

This book presents the proceedings of the 11th International Parallel Tools Workshop, a forum to discuss the latest advances in parallel tools, held September 11-12, 2017 in Dresden, Germany. High-performance computing plays an increasingly important role for numerical simulation and modeling in academic and industrial research. At the same time, using large-scale parallel systems efficiently is becoming more difficult. A number of tools addressing parallel program development and analysis has emerged from the high-performance computing community over the last decade, and what may have started as a collection of a small helper scripts has now matured into production-grade frameworks. Powerful user interfaces and an extensive body of documentation together create a user-friendly environment for parallel tools.

High-Performance Computing of Big Data for Turbulence and Combustion - Sergio Pirozzoli 2019-05-28

This book provides state-of-art information on high-accuracy scientific computing and its future prospects, as applicable to the broad areas of fluid mechanics and combustion, and across all speed regimes. Beginning with the concepts of space-time discretization and dispersion relation in numerical computing, the foundations are laid for the efficient solution of the Navier-Stokes equations, with special reference to prominent approaches such as LES, DES and DNS. The basis of high-accuracy computing is rooted in the concept of stability, dispersion and phase errors, which require the comprehensive analysis of discrete computing by rigorously applying error dynamics. In this context, high-order finite-difference and finite-volume methods are presented. Naturally, the coverage also includes fundamental notions of high-performance computing and advanced concepts on parallel computing, including their implementation in prospective hexascale computers. Moreover, the book seeks to raise the bar beyond the pedagogical use of high-accuracy computing by addressing more complex physical scenarios, including turbulent combustion. Tools like proper orthogonal decomposition (POD), proper generalized decomposition (PGD), singular value decomposition (SVD), recursive POD, and high-order SVD in multi-parameter spaces are presented. Special attention is paid to bivariate and multivariate datasets in connection with various canonical flow and heat transfer cases. The book mainly addresses the needs of researchers and doctoral students in mechanical engineering, aerospace engineering, and all applied disciplines including applied mathematics, offering these readers a unique resource.

Parallel Computational Fluid Dynamics 2008 - Damien Tromeur-Dervout 2010-09-21

This book collects the proceedings of the Parallel Computational Fluid Dynamics 2008 conference held in Lyon, France. Contributed papers by over 40 researchers representing the state of the art in parallel CFD and architecture from Asia, Europe, and North America examine major developments in (1) block-structured grid and boundary methods to simulate flows over moving bodies, (2) specific methods for optimization in Aerodynamics Design, (3) innovative parallel algorithms and numerical solvers, such as scalable algebraic multilevel preconditioners and the acceleration of iterative solutions, (4) software frameworks and component architectures for parallelism, (5) large scale computing and parallel efficiencies in the industrial context, (6) lattice Boltzmann and SPH methods, and (7) applications in the environment, biofluids, and nuclear engineering.

Liquid Propellant Rocket Combustion Instability - David T. Harrje 1972

Approximate Deconvolution Models of Turbulence - William J. Layton 2012-01-07

This volume presents a mathematical development of a recent approach to the modeling and simulation of turbulent flows based on methods for the approximate solution of inverse problems. The resulting Approximate Deconvolution Models or ADMs have some advantages over more commonly used turbulence models – as well as some disadvantages. Our goal in this book is to provide a clear and complete mathematical development of ADMs, while pointing out the difficulties that remain. In order to do so, we present the analytical theory of ADMs, along with its connections, motivations and complements in the phenomenology of and algorithms for ADMs.

Turbulent Combustion - Norbert Peters 2000-08-15

The combustion of fossil fuels remains a key technology for the foreseeable future. It is therefore important that we understand the mechanisms of combustion and, in particular, the role of turbulence within this process. Combustion always takes place within a turbulent flow field for two reasons: turbulence increases the mixing process and enhances combustion, but at the same time combustion releases heat which generates flow instability through buoyancy, thus enhancing the transition to turbulence. The four chapters of this book present a thorough introduction to the field of turbulent combustion. After an overview of modeling approaches, the three remaining chapters consider the three distinct cases of premixed, non-premixed, and partially premixed combustion, respectively. This book will be of value to researchers and students of engineering and applied mathematics by demonstrating the current theories of turbulent combustion within a unified presentation of the field.

High-Performance Scientific Computing - Edoardo Di Napoli 2017-03-01

This book constitutes the thoroughly refereed post-conference proceedings of the First JARA High-Performance Computing Symposium, JARA-HPC 2016, held in Aachen, Germany, in October 2016. The 21 full papers presented were carefully reviewed and selected from 26 submissions. They cover many diverse topics, such as coupling methods and strategies in Computational Fluid Dynamics (CFD), performance portability and applications in HPC, as well as provenance tracking for large-scale simulations.

Multicomponent Flow Modeling - Vincent Giovangigli 2012-12-06

The goal of this is book to give a detailed presentation of multicomponent flow models and to investigate the mathematical structure and properties of the resulting system of partial differential equations. These developments are also illustrated by simulating numerically a typical laminar flame. Our aim in the chapters is to treat the general situation of multicomponent flows, taking into account complex chemistry and detailed transport phe nomena. In this book, we have adopted an interdisciplinary approach that en compasses a physical, mathematical, and numerical point of view. In par ticular, the links between molecular models, macroscopic models, mathe matical structure, and mathematical properties are emphasized. We also often mention flame models since combustion is an excellent prototype of multicomponent flow. This book still does not pretend to be a complete survey of existing models and related mathematical results. In particular, many subjects like multi phase-flows , turbulence modeling, specific applications, porous me dia, biological models, or magneto-hydrodynamics are not covered. We rather emphasize the fundamental modeling of multicomponent gaseous flows and the qualitative properties of the resulting systems of partial dif ferential equations. Part of this book was taught at the post-graduate level at the Uni versity of Paris, the University of Versailles, and at Ecole

Poly technique in 1998-1999 to students of applied mathematics.
Scramjet Propulsion - E. T. Curran 2001

Modelling Fluid Flow - János Vad 2013-04-17
Modelling Fluid Flow presents invited lectures, workshop summaries and a selection of papers from a recent international conference CMFF '03 on fluid technology. The lectures follow the current evolution and the newest challenges of the computational methods and measuring techniques related to fluid flow. The workshop summaries reflect the recent trends, open questions and unsolved problems in the mutually inspiring fields of experimental and computational fluid mechanics. The papers cover a wide range of fluids engineering, including reactive flow, chemical and process engineering, environmental fluid dynamics, turbulence modelling, numerical methods, and fluid machinery.
Wildland Fire - Michael John Gollner 2020-08-28

Turbulent Premixed Flames - Nedunchezhian Swaminathan 2011-04-25
A work on turbulent premixed combustion is timely because of increased concern about the environmental impact of combustion and the search for new combustion concepts and technologies. An improved understanding of lean fuel turbulent premixed flames must play a central role in the fundamental science of these new concepts. Lean premixed flames have the potential to offer ultra-low emission levels, but they are notoriously susceptible to combustion oscillations. Thus, sophisticated control measures are inevitably required. The editors' intent is to set out the modeling aspects in the field of turbulent premixed combustion. Good progress has been made recently on this topic. Thus, it is timely to edit a cohesive volume containing contributions from international experts on various subtopics of the lean premixed flame problem.
Introduction to Quantum Computation and Information - Hoi-Kwong Lo 1998-10-15
This book aims to provide a pedagogical introduction to the subjects of quantum information and quantum computation. Topics include non-locality of quantum mechanics, quantum computation, quantum cryptography, quantum error correction, fault-tolerant quantum computation as well as some experimental aspects of quantum computation and quantum cryptography. Only knowledge of basic quantum mechanics is assumed. Whenever more advanced concepts and techniques are used, they are introduced carefully. This book is meant to be a self-contained overview. While basic concepts are discussed in detail, unnecessary technical details are excluded. It is well-suited for a wide audience ranging from physics graduate students to advanced researchers. This book is based on a lecture series held at Hewlett-Packard Labs, Basic Research Institute in the Mathematical Sciences (BRIMS), Bristol from November 1996 to April 1997, and also includes other contributions. Contents:Basic Elements of Quantum Information Technology (T P Spiller)The Joy of Entanglement (S Popescu & D Rohrlich)Quantum Information and Its Properties (R Jozsa)Quantum Cryptology (H-K Lo)Experimental Quantum Cryptography (H Zbinden)Quantum Computation: An Introduction (A Barenco)Quantum Error Correction (A M Steane)Fault-Tolerant Quantum Computation (J Preskill)Quantum Computers, Error-Corrrection and Networking: Quantum Optical Approaches (T Pellizzari)Quantum Computation with Nuclear Magnetic Resonance (I L Chuang)Future Directions for Quantum Information Theory (C H Bennett) Readership: Graduate students and advanced researchers in quantum/classical mechanics, quantum information & computation, theoretical foundations of computer science and information science. Keywords:Quantum Computation;Quantum Cryptography;Quantum Information;Quantum Teleportation;Quantum Error-Correction;Quantum Algorithm;Entanglement;Qubit;DecoherenceReviews: “The book fills a gap between the turgid prose of the burgeoning research literature and the superficial accounts in the popular press.” Nature “The concepts introduced in this book and the forecast of future directions provided should continue to provide a good primer for the exciting breakthrough anticipated in this field.” Mathematics Abstracts “Despite its age, this book remains an excellent way to learn the basics of quantum information.” Quantum Information and Computation “… the expositions are generally very beautiful, and the drawing together of many fundamental issues in one place is something that is extremely useful, given the wide background of ideas that go into the field … this is an excellent book for anyone who is starting out in the field and would like to have an overview of what the key issues are, and which directions of research are important, without being bogged down by heavy detail.” Contemporary Physics
Liquid Rocket Engine Combustion Instability - Vigor Young 1995
Annotation Since the invention of the V-2 rocket during World War II, combustion instabilities have been recognized as one of the most difficult problems in the development of liquid propellant rocket engines. This book is the first published in the United States on the subject since NASA's Liquid Rocket Combustion Instability (NASA SP-194) in 1972. In this book, experts cover four major subject areas: engine phenomenology and case studies, fundamental mechanisms of combustion instability, combustion instability analysis, and engine and component testing. Especially noteworthy is the inclusion of technical information from Russia and China--a first.