Singularities Formation Structure And Propagation By J Eggers

Provides a foundation for understanding complex fluids by integrating fluid dynamics, statistical physics, and polymer and colloid science. Explores a wide range of singular phenomena. Provides mathematical tools for understanding them and highlights their common features.
One service mathematics has rendered the 'Et moi ...) si j'avait su comment en revenir, human race. It has put common sense back je n'y serais point aile.' Jules Verne where it belongs, on the topmost shelf next to the dusty canister labelled 'discarded non The series is divergent; therefore we may be sense'. ErieT. Bell able to do something with it. O. Heaviside Mathematics is a tool for thought. A highly necessary tool in a world where both feedback and non linearities abound. Similarly, all kinds of parts of mathematics serve as tools for other parts and for other sciences. Applying a simple rewriting rule to the quote on the right above one finds such statements as: 'One service topology has rendered mathematical physics .. .'; 'One service logic has rendered com puter science .. .'; 'One service category theory has rendered mathematics .. .'. All arguably true. And all statements obtainable this way form part of the raison d'etre of this series.
This volume contains the proceedings of the Summer Program on Nonlinear Conservation Laws and Applications held at the IMA on July 13--31, 2009. Hyperbolic conservation laws is a classical subject, which has experienced vigorous growth in recent years. The present collection provides a timely survey of the state of the art in this exciting field, and a comprehensive outlook on open problems. Contributions of more theoretical nature cover the following topics: global existence and uniqueness theory of one-dimensional systems, multidimensional conservation laws in several space variables and approximations of their solutions, mathematical analysis of fluid motion, stability and dynamics of viscous shock waves, singular limits for viscous systems, basic principles in the modeling of turbulent mixing, transonic flows past an obstacle and a fluid dynamic approach for isometric embedding in geometry, models of nonlinear elasticity, the Monge problem, and transport equations with rough coefficients. In addition, there are a number of papers devoted to applications. These include: models of blood flow, self-gravitating compressible fluids, granular flow, charge transport in fluids, and the modeling and control of traffic flow on networks.
This book features chapters based on lectures presented by world-leading researchers of photon science from Russia and Japan at the first “STEPS Symposium on Photon Science” held in Tokyo in March 2015. It describes recent progress in the field of photon science, covering a wide range of interest to experts in the field, including laser-plasma interaction, filamentation and its applications, laser assisted electron scattering, exotic properties of light, ultrafast imaging, molecules and clusters in intense laser fields, photochemistry and spectroscopy of novel materials, laser-assisted material synthesis, and photon technology.
A pedagogical review of the mathematical modelling in fluid dynamics necessary to understand the motility of most microorganisms on Earth.
Treats the origin of magnetic fields in planets, stars and galaxies, and the manner of their evolution over time.
This guide to computational fluid mechanics introduces beginning graduate students to the subject's standard methods and common pitfalls.
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The Frontiers in Materials Editorial Office team are delighted to present the inaugural “Frontiers in Materials: Rising Stars” article collection, showcasing the high-quality work of internationally recognized researchers in the early stages of their independent careers. All Rising Star researchers featured within this collection were individually nominated by the Journal’s Chief Editors in recognition of their potential to influence the future directions in their respective fields. The work presented here highlights the diversity of research performed across the entire breadth of the materials science and engineering field, and presents advances in theory, experiment and methodology with applications to compelling problems. This Editorial features the corresponding author(s) of each paper published within this important collection, ordered by section alphabetically, highlighting them as the great researchers of the future. The Frontiers in Materials Editorial Office team would like to thank each researcher who contributed their work to this collection. We would also like to personally thank our Chief Editors for their exemplary leadership of this article collection; their strong support and passion for this important, community-driven collection has ensured its success and global impact. Laurent Mathey, PhD Journal Development Manager
This book is about the pattern formation and the evolution of crack propagation in engineering materials and structures, bridging mathematical analyses of cracks based on singular integral equations, to computational simulation of engineering design. The first two parts of this book focus on elasticity and fracture and provide the basis for discussions on fracture morphology and its numerical simulation, which may lead to a simulation-based fracture control in engineering structures. Several design concepts are discussed for the prevention of fatigue and fracture in engineering structures, including safe-life design, fail-safe design, damage tolerant design. After starting with basic elasticity and fracture theories in parts one and two, this book focuses on the fracture morphology that develops due to the propagation of brittle cracks or fatigue cracks. In part three, the mathematical analysis of a curved crack is precisely described, based on the perturbation method. The stability theory of interactive cracks propagating in brittle solids may help readers to understand the formation of a fractal-like cracking patterns in brittle solids, while the stability theory of crack paths helps to identify the straight versus sharply curved or sometimes wavy crack paths observed in brittle solids. In part four, the numerical simulation method of a system of multiple cracks is introduced by means of the finite element method, which may be used for the better implementation of fracture control in engineering structures. This book is part of a series on “Mathematics for Industry” and will appeal to structural engineers seeking to understand the basic backgrounds of analyses, but also to mathematicians with an interest in how such mathematical solutions are evaluated in industrial applications.
Comprehensive textbook prioritising physical ideas over mathematical detail. New material includes fusion plasma magnetohydrodynamics.
This self-contained introduction to numerical linear algebra provides a comprehensive, yet concise, overview of the subject. It includes standard material such as direct methods for solving linear systems and least-squares problems, error, stability and conditioning, basic iterative methods and the calculation of eigenvalues. Later chapters cover more advanced material, such as Krylov subspace methods, multigrid methods, domain decomposition methods, multipole expansions, hierarchical matrices and compressed sensing. The book provides rigorous mathematical proofs throughout, and gives algorithms in general-purpose language-independent form. Requiring only a solid knowledge in linear algebra and basic analysis, this book will be useful for applied mathematicians, engineers, computer scientists, and all those interested in efficiently solving linear problems.
This IMA Volume in Mathematics and its Applications PATTERN FORMATION IN CONTINUOUS AND COUPLED SYSTEMS is based on the proceedings of a workshop with the same title, but goes be yond the proceedings by presenting a series of mini-review articles that sur vey, and provide an introduction to, interesting problems in the field. The workshop was an integral part of the 1997-98 IMA program on "EMERG ING APPLICATIONS OF DYNAMICAL SYSTEMS." I would like to thank Martin Golubitsky, University of Houston (Math ematics) Dan Luss, University of Houston (Chemical Engineering), and Steven H. Strogatz, Cornell University (Theoretical and Applied Mechan ics) for their excellent work as organizers of the meeting and for editing the proceedings. I also take this opportunity to thank the National Science Foundation (NSF), and the Army Research Office (ARO), whose financial support made the workshop possible. Willard Miller, Jr., Professor and Director v PREFACE Pattern formation has been studied intensively for most of this cen tury by both experimentalists and theoreticians, and there have been many workshops and conferences devoted to the subject. In the IMA workshop on Pattern Formation in Continuous and Coupled Systems held May 11-15, 1998 we attempted to focus on new directions in the patterns literature.
This 121st IMA volume, entitled MATHEMATICAL MODELS FOR BIOLOGICAL PATTERN FORMATION is the first of a new series called FRONTIERS IN APPLICATION OF MATHEMATICS. The FRONTIERS volumes are motivated by IMA pro grams and workshops, but are specially planned and written to provide an entree to and assessment of exciting new areas for the application of mathematical tools and

analysis. The emphasis in FRONTIERS volumes is on surveys, exposition and outlook, to attract more mathematicians and other scientists to the study of these areas and to focus efforts on the most important issues, rather than papers on the most recent research results aimed at an audience of specialists. The present volume of peer-reviewed papers grew out of the 1998-99 IMA program on "Mathematics in Biology," in particular the Fall 1998 em phasis on "Theoretical Problems in Developmental Biology and Immunol ogy." During that period there were two workshops on Pattern Formation and Morphogenesis, organized by Professors Murray, Maini and Othmer. James Murray was one of the principal organizers for the entire year pro gram. I am very grateful to James Murray for providing an introduction, and to Philip Maini and Hans Othmer for their excellent work in planning and preparing this first FRONTIERS volume. I also take this opportunity to thank the National Science Foundation, whose financial support of the IMA made the Mathematics in Biology pro gram possible.

Coherence and chaos in partial differential equations was studied, with particular emphasis on the damped-driven sine Gordon equation and an optically bistable laser cavity. The propagation of rapidly oscillating nonlinear integrable waves was investigated. The results about propagation in an optically bistable ring cavity the identification of the interplay between coherent transverse spatial structures and temporal chaos in the characteristics of the laser beam. Principal mathematical results on the damped-driven sine-Gordon equation include a numerical study of low dimensional chaotic attractors with coherent spatial structures, including dynamical system diagnostics of their time series, and direct numerical measurements establishing that the attractor is well co-ordinatized by a few nonlinear normal modes; complete analytical identification of all homoclinic structures for the integrable sine-Gordon equation; direct numerical detection of homoclinic crossings along the chaotic attractor of the full syste, . Principal mathematical results about the propagation of rapidly oscillating integrable waves include the identification and derivation of a Hamiltonian structure for the modulation equations and a study of the process by which singularities are smoothed by dispersion through the injection of additional degrees of freedom into the field. (jhd).

This book is an interdisciplinary introduction to optical collapse of laser beams, which is modelled by singular (blow-up) solutions of the nonlinear Schrödinger equation. With great care and detail, it develops the subject including the mathematical and physical background and the history of the subject. It combines rigorous analysis, asymptotic analysis, informal arguments, numerical simulations, physical modelling, and physical experiments. It repeatedly emphasizes the relations between these approaches, and the intuition behind the results. The Nonlinear Schrödinger Equation will be useful to graduate students and researchers in applied mathematics who are interested in singular solutions of partial differential equations, nonlinear optics and nonlinear waves, and to graduate students and researchers in physics and engineering who are interested in nonlinear optics and Bose-Einstein condensates. It can be used for courses on partial differential equations, nonlinear waves, and nonlinear optics. Gadi Fibich is a Professor of Applied Mathematics at Tel Aviv University. “This book provides a clear presentation of the nonlinear Schrodinger equation and its applications from various perspectives (rigorous analysis, informal analysis, and physics). It will be extremely useful for students and researchers who enter this field.” Frank Merle, Université de Cergy-Pontoise and Institut des Hautes Études Scientifiques, France

Many key phenomena in physics and engineering are described as singularities in the solutions to the differential equations describing them. Examples covered thoroughly in this book include the formation of drops and bubbles, the propagation of a crack and the formation of a shock in a gas. Aimed at a broad audience, this book provides the mathematical tools for understanding singularities and explains the many common features in their mathematical structure. Part I introduces the main concepts and techniques, using the most elementary mathematics possible so that it can be followed by readers with only a general background in differential equations. Parts II and III require more specialised methods of partial differential equations, complex analysis and asymptotic techniques. The book may be used for advanced fluid mechanics courses and as a complement to a general course on applied partial differential equations.

Acoustical engineers, researchers, architects, and designers need a comprehensive, single-volume reference that provides quick and convenient access to important information, answers and questions on a broad spectrum of topics, and helps solve the toughest problems in acoustical design and engineering. The Handbook of Acoustics meets that need. It offers concise coverage of the science and engineering of acoustics and vibration. In more than 100 clearly written chapters, experts from around the world share their knowledge and expertise in topics ranging from basic aerodynamics and jet noise to acoustical signal processing, and from the interaction of fluid motion and sound to infrasound, ultrasonics, and quantum acoustics. Topics covered include: * General linear acoustics * Nonlinear acoustics and cavitation * Aeroacoustics and atmospheric sound * Mechanical vibrations and shock * Statistical methods in acoustics * Architectural acoustics * Physiological acoustics * Underwater sound * Ultrasonics, quantum acoustics, and physical aspects of sound * Noise: its effects and control * Acoustical signal processing * Psychological acoustics * Speech communication * Music and musical acoustics * Acoustical measurements and instrumentation * Transducers The Handbook of Acoustics belongs on the reference shelf of every engineer, architect, research scientist, or designer with a professional interest in the propagation, control, transmission, and effects of sound.

Practical introduction for advanced undergraduate or beginning graduate students of applied mathematics, developed at the University of Oxford.

When we first heard in the spring of 2000 that the Seminaire de matMmatiques superieures (SMS) was interested in devoting its session of the summer of 200l-its 40th-to scientific computing the idea of taking on the organizational work seemed to us somewhat remote. More immediate things were on our minds: one of us was about to go on leave to the Courant Institute, the other preparing for a research summer in Paris. But the more we learned about the possibilities of such a seminar, the support for the organization and also the great history of the SMS, the more we grew attached to the project. The topics we planned to cover were intended to span a wide range of theoretical and practical tools for solving problems in image processing, thin films, mathematical finance, electrical engineering, moving interfaces, and combustion. These applications alone show how wide the influence of scientific computing has become over the last two decades: almost any area of science and engineering is greatly influenced by simulations, and the SMS workshop in this field came very timely. We decided to organize the workshop in pairs of speakers for each of the eight topics we had chosen, and we invited the leading experts worldwide in these fields. We were very fortunate that every speaker we invited accepted to come, so the program could be realized as planned.

In the past several decades, the research on spin transport and magnetism has led to remarkable scientific and technological breakthroughs, including Albert Fert and Peter Grunberg's Nobel Prize-winning discovery of giant magnetoresistance (GMR) in magnetic metallic multilayers. Handbook of Spin Transport and Magnetism provides a comprehensive, bal

An introduction to complex variables that caters for undergraduate students in applied mathematics, science, and engineering.

Singularities: Formation, Structure, and PropagationCambridge University Press

A rigorous introduction to geometric and topological inference, for anyone interested in a geometric approach to data science.

It is difficult to overestimate the importance of mathematical investigation of balance laws. They arise in many areas of physics, mechanics, chemistry, biology, social sciences. In this collective book we concentrate in particular on the equations of continuous medium and related to them. As a rule, they are very complicated in their primitive form. An

important feature of such equations is a possible formation of singularities even in initially smooth solution within a finite time. The structure of the singularities can be very complex. A natural step in the approach to this problem is the transition, despite the three-dimensionality of our world, to spatially one-dimensional model. Significant progress has been achieved in this direction. Unfortunately, the methods of the one-dimensional theory, as usual, cannot be adapted to a case of many spatial variables. However, there are many attempts to deal with multidimensional problems. We would like to present some of them. All of the papers are written by outstanding experts, representing various schools in mathematics and mechanics. Each paper is organised as follows: it contains an elementary (as far as it is possible) introduction to a problem, a brief review of previously published results, and then original results of the authors are presented.

Reviews developments in applications of inhomogeneous models to cosmology, for graduate students and academic researchers in astrophysics.

In continuation of the FRINGE Workshop Series this Proceeding contains all contributions presented at the 7. International Workshop on Advanced Optical Imaging and Metrology. The FRINGE Workshop Series is dedicated to the presentation, discussion and dissemination of recent results in Optical Imaging and Metrology. Topics of particular interest for the 7. Workshop are: - New methods and tools for the generation, acquisition, processing, and evaluation of data in Optical Imaging and Metrology (digital wavefront engineering, computational imaging, model-based reconstruction, compressed sensing, inverse problems solution) - Application-driven technologies in Optical Imaging and Metrology (high-resolution, adaptive, active, robust, reliable, flexible, in-line, real-time) - High-dynamic range solutions in Optical Imaging and Metrology (from macro to nano) - Hybrid technologies in Optical Imaging and Metrology (hybrid optics, sensor and data fusion, model-based solutions, multimodality) - New optical sensors, imaging and measurement systems (integrated, miniaturized, in-line, real-time, traceable, remote) Special emphasis is put on new strategies, taking into account the active combination of physical modeling, computer aided simulation and experimental data acquisition. In particular attention is directed towards new approaches for the extension of existing resolution limits that open the gates to wide-scale metrology, ranging from macro to nano, by considering dynamic changes and using advanced optical imaging and sensor systems.

The International Conference on "Hyperbolic Problems: Theory, Numerics and Applications" was held in CalTech on March 25-30, 2002. The conference was the ninth meeting in the bi-annual international series which became one of the highest quality and most successful conference series in Applied mathematics. This volume contains more than 90 contributions presented in this conference, including plenary presentations by A. Bressan, P. Degond, R. LeVeque, T.-P. Liu, B. Perthame, C.-W. Shu, B. Sjögreen and S. Ukai. Reflecting the objective of series, the contributions in this volume keep the traditional blend of theory, numerics and applications. The Hyp2002 meeting placed a particular emphasize on fundamental theory and numerical analysis, on multi-scale analysis, modeling and simulations, and on geophysical applications and free boundary problems arising from materials science and multi-component fluid dynamics. The volume should appeal to researchers, students and practitioners with general interest in time-dependent problems governed by hyperbolic equations.

The Dictionary of Geophysics, Astrophysics, and Astronomy provides a lexicon of terminology covering fields such as astronomy, astrophysics, cosmology, relativity, geophysics, meteorology, Newtonian physics, and oceanography. Authors and editors often assume - incorrectly - that readers are familiar with all the terms in professional literature. With over 4,000 definitions and 50 contributing authors, this unique comprehensive dictionary helps scientists to use terminology correctly and to understand papers, articles, and books in which physics-related terms appear.

The first comprehensive introduction to the powerful moment approach for solving global optimization problems.

Structured singular light is an ubiquitous phenomenon. It is not only created when light refracts at a water surface but can also be found in the blue daytime sky. Such light fields include a spatially varying amplitude, phase, or polarization, enabling the occurrence of optical singularities. As structurally stable units of the light field, these singularities are particularly interesting since they determine its topology. In this excellent book, the author presents a pioneering study of structured singular light, thereby contributing many original approaches. Especially in the field of polarization and its rich number of different types of singularities the book defines and drives a completely new field. The work demonstrates how to control complex polarization singularity networks and their propagation. Additionally, the author pioneers tightly focusing vectorial beams, also developing an urgently needed detection scheme for three-dimensional nanoscale polarization structures. She also studies classical spatial entanglement using structured light, introducing entanglement beating and paraxial spin-orbit-coupling. The book is hallmarked by its comprehensive and thorough way of describing a plethora of different approaches to structure light by amplitude, phase and polarization, as well as the important role of optical singularities.

The Fourth International Colloquium on Differential Equations was organized by UNESCO and the Plovdiv Technical University, with the help of many international mathematical organizations, and was held in Plovdiv, Bulgaria, 18--22 August 1993. This proceedings volume contains selected invited talks which deal with the following topics: -- impulsive differential equations -- nonlinear differential equations -- differential equations with maxima -- applications of differential equations

Abstract: "In this work we study the generation and propagation of singularities (shock waves) of the solution of the Cauchy problem for Hamilton-Jacobi equations in one space variable, under no assumption on convexity or concavity of the hamiltonian. We study the problem in the class of viscosity solutions, which are the correct class of weak solutions. We obtain the exact global structure of the shock waves by studying the way the characteristics cross. We construct the viscosity solution by either selecting a single-valued branch of the multi-valued function given as a solution by the method of characteristics or constructing explicitly the proper rarefaction waves."

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