Mathematical Problems In Semiconductor Physics Lectures Given At The Cime Summer School Held In Cetraro Italy June 15 22 1998 Lecture Notes In Mathematics

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Mathematics Inspired by Biology - O. Diekmann 2006-11-15
The summer school on Mathematics inspired by Biology was held at Martina Franca, Apulia, Italy in 1997. This volume presents five series of six lectures each. The common theme is the role of structure in shaping transient and ultimate dynamics. But the type of structure ranges from spatial (hadeler and maini in the deterministic setting, Durrett in the stochastic setting) to physiological (Diekmann) and order (Smith). Each contribution sketches the present state of affairs while, by including some wishful thinking, pointing at open problems that deserve attention.
Computational Mathematics Driven by Industrial Problems - R. Burkard 2007-05-06
These lecture notes by very authoritative scientists survey recent advances of mathematics driven by industrial application showing not only how mathematics is applied to industry but also how mathematics has drawn benefit from interaction with real-word problems. The famous David Report underlines that innovative high technology depends crucially for its development on innovation in mathematics. The speakers include three recent presidents of ECMI, one of ECCOMAS (in Europe) and the president of SIAM.
Nonlinear and Optimal Control Theory - Andrei A. Agrachev 2008-06-24
The lectures gathered in this volume present some of the different aspects of Mathematical Control Theory. Adopting the point of view of Geometric Control Theory and of Nonlinear Control Theory, the lectures focus on some aspects of the Optimization and Control of nonlinear, not necessarily smooth, dynamical systems. Specifically, three of the five lectures discuss respectively: logic-based switching control, sliding mode control and the input to the state stability paradigm for the control and stability of nonlinear systems. The remaining two lectures are devoted to Optimal Control: one investigates the connections between Optimal Control Theory, Dynamical Systems and Differential Geometry, while the second presents a very general version, in a non-smooth context, of the Pontryagin Maximum Principle. The arguments of the whole volume are self-contained and are directed to everyone working in Control Theory. They offer a sound presentation of the methods employed in the control and optimization of nonlinear dynamical systems.
Mixed Finite Elements, Compatibility Conditions, and Applications - Daniele Boffi 2008-04-01
Since the early 70's, mixed finite elements have been the object of a wide and deep study by the mathematical and engineering communities. The fundamental role of this method for many application fields has been worldwide recognized and its use has been introduced in several commercial codes. An important feature of mixed finite elements is the interplay between theory and application. Discretization spaces for mixed schemes require suitable compatibilities, so that simple minded approximations generally do not work and the design of appropriate stabilizations gives rise to challenging mathematical problems. This volume collects the lecture notes of a C.I.M.E. course held in Summer 2006, when some of the most world recognized experts in the field reviewed the rigorous setting of mixed finite elements and revisited it after more than 30 years of practice. Applications, in this volume, range from traditional ones, like fluid-dynamics or elasticity, to more recent and active fields, like electromagnetism.
Progress in Industrial Mathematics at ECMI 2014 - Giovanni Russo 2017-09-04
This book presents a collection of papers emphasizing applications of mathematical models and methods to real-world problems of relevance for industry, life science, environment, finance and so on. The biannual Conference of ECMI (the European Consortium of Mathematics in Industry) held in 2014 focused on various aspects of industrial and applied mathematics. The five main topics addressed at the conference were mathematical models in life science, material science and semiconductors, mathematical methods in the environment, design automation and industrial applications, and computational finance. Several other topics have been treated, such as, among others, optimization and inverse problems, education, numerical methods for stiff pdes, model reduction, imaging processing, multi physics simulation, mathematical models in textile industry. The conference, which brought together applied mathematicians and experts from industry, provided a unique opportunity to exchange ideas, problems and methodologies, bridging the gap between mathematics and industry and contributing to the advancement of science and technology. The conference has included a presentation of EU-Maths-In (European Network of Mathematics for Industry and Innovation), a recent joint initiative of ECMI and EMS. The proceedings from this conference represent a snapshot of the current activity in industrial mathematics in Europe, and are highly relevant to anybody interested in the latest applications of mathematics to industrial problems.
Multiscale Problems and Methods in Numerical Simulations - James H. Bramble 2003-12-15
This volume aims to disseminate a number of new ideas that have emerged in the last few years in the field of numerical simulation, all bearing the common denominator of the "multiscale" or "multilevel" paradigm. This covers the presence of multiple relevant "scales" in a physical phenomenon; the detection and representation of "structures", localized in space or in frequency, in the solution of a mathematical model; the decomposition of a function into "details" that can be organized and accessed in decreasing order of importance; and the iterative solution of systems of linear algebraic equations using "multilevel" decompositions of finite dimensional spaces.
Calculus of Variations and Nonlinear Partial Differential Equations - Centro internazionale matematico estivo. Summer School 2008-01-02
With a historical overview by Elvira Mascolo
Arithmetic Geometry - Jean-Louis Colliot-Thélène 2010-10-27
Arithmetic Geometry can be defined as the part of Algebraic Geometry connected with the study of algebraic varieties through arbitrary rings, in particular through non-algebraically closed fields. It lies at the intersection between classical algebraic geometry and number theory. A C.I.M.E. Summer School devoted to arithmetic geometry was held in Cetraro, Italy in September 2007, and presented some of the most interesting new developments in arithmetic geometry. This book collects the lecture notes which were written up by the speakers. The main topics concern diophantine equations, local-global principles, diophantine approximation and its relations to Nevanlinna theory, and rationally connected varieties. The book is divided into three parts, corresponding to the courses given by J-L Colliot-Thelene, Peter Swinnerton Dyer and Paul Vojta.

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Enumerative Invariants in Algebraic Geometry and String Theory - Marcos Marino 2008-08-22
Starting in the middle of the 80s, there has been a growing and fruitful interaction between algebraic geometry and certain areas of theoretical high-energy physics, especially the various versions of string theory. Physical heuristics have provided inspiration for new mathematical definitions (such as that of Gromov-Witten invariants) leading in turn to the solution of problems in enumerative geometry. Conversely, the availability of mathematically rigorous definitions and theorems has benefited the physics research by providing the required evidence in fields where experimental testing seems problematic. The aim of this volume, a result of the CIME Summer School held in Cetraro, Italy, in 2005, is to cover part of the most recent and interesting findings in this subject.
Nonlinear Optimization - Immanuel M. Bomze 2010-03-17
This volume collects the expanded notes of four series of lectures given on the occasion of the CIME course on Nonlinear Optimization held in Cetraro, Italy, from July 1 to 7, 2007. The Nonlinear Optimization problem of main concern here is the problem n of determining a vector of decision variables x ? R that minimizes (ma- n mizes) an objective function f(·): R ? R,when x is restricted to belong n to some feasible setF? R , usually described by a set of equality and - n n m equality constraints: F = {x ? R : h(x)=0,h(·): R ? R ; g(x) ? 0, n p g(·): R ? R }; of course it is intended that at least one of the functions f,h,g is nonlinear. Although the problem canbe stated in verysimpleterms, its solution may result very di?cult due to the analytical properties of the functions involved and/or to the number n,m,p of variables and constraints. On the other hand, the problem has been recognized to be of main relevance in engineering, economics, and other applied sciences, so that a great lot of e?ort has been devoted to develop methods and algorithms able to solve the problem even in its more di?cult and large instances. The lectures have been given by eminent scholars, who contributed to a great extent to the development of Nonlinear Optimization theory, methods and algorithms. Namely, they are: – Professor Immanuel M.
Calculus of Variations and Geometric Evolution Problems - F. Bethuel 2006-11-14
The international summer school on Calculus of Variations and Geometric Evolution Problems was held at Cetraro, Italy, 1996. The contributions to this volume reflect quite closely the lectures given at Cetraro which have provided an image of a fairly broad field in analysis where in recent years we have seen many important contributions. Among the topics treated in the courses were variational methods for Ginzburg-Landau equations, variational models for microstructure and phase transitions, a variational treatment of the Plateau problem for surfaces of prescribed mean curvature in Riemannian manifolds - both from the classical point of view and in the setting of geometric measure theory.
Noncommutative Geometry - Alain Connes 2003-12-15
Noncommutative Geometry is one of the most deep and vital research subjects of present-day Mathematics. Its development, mainly due to Alain Connes, is providing an increasing number of applications and deeper insights for instance in Foliations, K-Theory, Index Theory, Number Theory but also in Quantum Physics of elementary particles. The purpose of the Summer School in Martina Franca was to offer a fresh invitation to the subject and closely related topics; the contributions in this volume include the four main lectures, cover advanced developments and are delivered by prominent specialists.
Paris-Princeton Lectures on Mathematical Finance 2010 - Areski Cousin 2010-10-06
The Paris-Princeton Lectures in Financial Mathematics, of which this is the fourth volume, publish cutting-edge research in self-contained, expository articles from outstanding specialists - established or on the rise! The aim is to produce a series of articles that can serve as an introductory reference source for research in the field. The articles are the result of frequent exchanges between the finance and financial mathematics groups in Paris and Princeton. The present volume sets standards with five articles by: 1. Areski Cousin, Monique Jeanblanc and Jean-Paul Laurent, 2. Stéphane Crépey, 3. Olivier Guéant, Jean-Michel Lasry and Pierre-Louis Lions, 4. David Hobson and 5. Peter Tankov.
Dynamical Systems and Small Divisors - Hakan Eliasson 2004-10-11
Many problems of stability in the theory of dynamical systems face the difficulty of small divisors. The most famous example is probably given by Kolmogorov-Arnold-Moser theory in the context of Hamiltonian systems, with many applications to physics and astronomy. Other natural small divisor problems arise considering circle diffeomorphisms or quasiperiodic Schroedinger operators. In this volume Hakan Eliasson, Sergei Kuksin and Jean-Christophe Yoccoz illustrate the most recent developments of this theory both in finite and infinite dimension. A list of open problems (including some problems contributed by John Mather and Michel Herman) has been included.
System Reduction for Nanoscale IC Design - Peter Benner 2017-06-02
This book describes the computational challenges posed by the progression toward nanoscale electronic devices and increasingly short design cycles in the microelectronics industry, and proposes methods of model reduction which facilitate circuit and device simulation for specific tasks in the design cycle. The goal is to develop and compare methods for system reduction in the design of high dimensional nanoelectronic ICs, and to test these methods in the practice of semiconductor development. Six chapters describe the challenges for numerical simulation of nanoelectronic circuits and suggest model reduction methods for constituting equations. These include linear and nonlinear differential equations tailored to circuit equations and drift diffusion equations for semiconductor devices. The performance of these methods is illustrated with numerical experiments using real-world data. Readers will benefit from an up-to-date overview of the latest model reduction methods in computational nanoelectronics.
More Progresses in Analysis - 2009-05-12
International ISAAC (International Society for Analysis, its Applications and Computation) Congresses have been held every second year since 1997. The proceedings report on a regular basis on the progresses of the field in recent years, where the most active areas in analysis, its applications and computation are covered. Plenary lectures also highlight recent results. This volume concentrates mainly on partial differential equations, but also includes function spaces, operator theory, integral transforms and equations, potential theory, complex analysis and generalizations, stochastic analysis, inverse problems, homogenization, continuum mechanics, mathematical biology and medicine. With over 350 participants attending the congress, the book comprises 140 papers from 211 authors. The volume also serves for transferring personal information about the ISAAC and its members. This volume includes citations for O. Besov, V. Burenkov and R.P. Gilbert on the occasion of their anniversaries.
Progress in Industrial Mathematics at ECMI 2006 - Luis L. Bonilla 2007-12-24
Proceedings from the 14th European Conference for Mathematics in Industry held in Madrid present innovative numerical and mathematical techniques. Topics include the latest applications in aerospace, information and communications, materials, energy and environment, imaging, biology and biotechnology, life sciences, and finance. In addition, the conference also delved into education in industrial mathematics and web learning.
Advanced Numerical Approximation of Nonlinear Hyperbolic Equations - B. Cockburn 2006-11-14
This volume contains the texts of the four series of lectures presented by B.Cockburn, C.Johnson, C.W. Shu and E.Tadmor at a C.I.M.E. Summer School. It is aimed at providing a comprehensive and up-to-date presentation of numerical methods which are nowadays used to solve nonlinear partial differential equations of hyperbolic type, developing shock discontinuities. The most effective methodologies in the framework of finite elements, finite differences, finite volumes spectral methods and kinetic methods, are addressed, in particular high-order shock capturing techniques, discontinuous Galerkin methods, adaptive techniques based upon a-posteriori error analysis.
Mathematical Problems in Semiconductor Physics - Angelo Marcello Anile 2003-09-16
On the the mathematical aspects of the theory of carrier transport in semiconductor devices. The subjects covered include hydrodynamical models for semiconductors based on the maximum entropy principle of extended thermodynamics, mathematical theory of drift-diffusion equations with applications, and the methods of asymptotic analysis.
Nonlinear and Optimal Control Theory - 2008

Model Reduction for Circuit Simulation - Peter Benner 2011-03-25
Simulation based on mathematical models plays a major role in computer aided design of integrated circuits (ICs). Decreasing structure sizes, increasing packing densities and driving frequencies require the use of refined mathematical models, and to take into account secondary, parasitic effects. This leads to very high dimensional problems which nowadays require simulation times too large for the short time-to-market demands in industry. Modern Model Order Reduction (MOR) techniques

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present a way out of this dilemma in providing surrogate models which keep the main characteristics of the device while requiring a significantly lower simulation time than the full model. With Model Reduction for Circuit Simulation we survey the state of the art in the challenging research field of MOR for ICs, and also address its future research directions. Special emphasis is taken on aspects stemming from miniturisations to the nano scale. Contributions cover complexity reduction using e.g., balanced truncation, Krylov-techniques or POD approaches. For semiconductor applications a focus is on generalising current techniques to differential-algebraic equations, on including design parameters, on preserving stability, and on including nonlinearity by means of piecewise linearisations along solution trajectories (TPWL) and interpolation techniques for nonlinear parts. Furthermore the influence of interconnects and power grids on the physical properties of the device is considered, and also top-down system design approaches in which detailed block descriptions are combined with behavioral models. Further topics consider MOR and the combination of approaches from optimisation and statistics, and the inclusion of PDE models with emphasis on MOR for the resulting partial differential algebraic systems. The methods which currently are being developed have also relevance in other application areas such as mechanical multibody systems, and systems arising in chemistry and to biology. The current number of books in the area of MOR for ICs is very limited, so that this volume helps to fill a gap in providing the state of the art material, and to stimulate further research in this area of MOR. Model Reduction for Circuit Simulation also reflects and documents the vivid interaction between three active research projects in this area, namely the EU-Marie Curie Action ToK project O-MOORE-NICE (members in Belgium, The Netherlands and Germany), the EU-Marie Curie Action RTN-project COMSON (members in The Netherlands, Italy, Germany, and Romania), and the German federal project System reduction in nano-electronics (SyreNe).

System Modeling and Optimization - Dietmar Hömberg 2013-02-20

This book is a collection of thoroughly refereed papers presented at the 25th IFIP TC 7 Conference on System Modeling and Optimization, held in Dresden, Germany, in September 2011. The 55 revised papers were carefully selected from numerous submissions. They are organized in the following topical sections: control of distributed parameter systems; stochastic optimization and control; stabilization, feedback, and model predictive control; flow control; shape and structural optimization; and applications and control of lumped parameter systems.

SPDE in Hydrodynamics: Recent Progress and Prospects - Sergio Albeverio 2008-04-01

Of the three lecture courses making up the CIME summer school on Fluid Dynamics at Cetraro in 2005 reflected in this volume, the first, due to Sergio Albeverio describes deterministic and stochastic models of hydrodynamics. In the second course, Franco Flandoli starts from 3D Navier-Stokes equations and ends with turbulence. Finally, Yakov Sinai, in the 3rd course, describes some rigorous mathematical results for multidimensional Navier-Stokes systems and some recent results on the one-dimensional Burgers equation with random forcing.

Geometric Analysis and PDEs - Matthew J. Gursky 2009-06-26

This volume contains lecture notes on key topics in geometric analysis, a growing mathematical subject which uses analytical techniques, mostly of partial differential equations, to treat problems in differential geometry and mathematical physics.

Filtration in Porous Media and Industrial Application - M.S. Espedal 2007-05-06

This book is devoted to the presentation of some flow problems in porous media having relevant industrial applications. The main topics covered are: the manufacturing of composite materials, the espresso coffee brewing process, the filtration of liquids through diapers, various questions about flow problems in oil reservoirs and the theory of homogenization. The aim is to show that filtration problems arising in very practical industrial context exhibit interesting and highly nontrivial mathematical aspects. Thus the style of the book is mathematically rigorous, but specifically oriented towards applications, so that it is intended for both applied mathematicians and researchers in various areas of technological interest. The reader is required to have a good knowledge of the classical theory of PDE and basic functional analysis.

More Progresses in Analysis -

Representation Theory and Complex Analysis - Michael Cowling 2008-02-22

Six leading experts lecture on a wide spectrum of recent results on the subject of the title. They present a survey of various interactions between representation theory and harmonic analysis on semisimple groups and symmetric spaces, and recall the concept of amenability. They further illustrate how representation theory is related to quantum computing; and much more. Taken together, this volume provides both a solid reference and deep insights on current research activity.

Analytic Number Theory - J. B. Friedlander 2006

Optimal Shape Design - B. Kawohl 2007-05-06

Optimal Shape Design is concerned with the optimization of some performance criterion dependent (besides the constraints of the problem) on the "shape" of some region. The main topics covered are: the optimal design of a geometrical object, for instance a wing, moving in a fluid; the optimal shape of a region (a harbor), given suitable constraints on the size of the entrance to the harbor, subject to incoming waves; the optimal design of some electrical device subject to constraints on the performance. The aim is to show that Optimal Shape Design, besides its interesting industrial applications, possesses nontrivial mathematical aspects. The main theoretical tools developed here are the homogenization method and domain variations in PDE. The style is mathematically rigorous, but specifically oriented towards applications, and it is intended for both pure and applied mathematicians. The reader is required to know classical PDE theory and basic functional analysis.

Hyperbolic Systems of Balance Laws - Alberto Bressan 2007-05-26

This volume includes four lecture courses by Bressan, Serre, Zumbrun and Williams and a Tutorial by Bressan on the Center Manifold Theorem. Bressan introduces the vanishing viscosity approach and clearly explains the building blocks of the theory. Serre focuses on existence and stability for discrete shock profiles. The lectures by Williams and Zumbrun deal with the stability of multidimensional fronts.

Symplectic 4-Manifolds and Algebraic Surfaces - Fabrizio Catanese 2008-04-17

Modern approaches to the study of symplectic 4-manifolds and algebraic surfaces combine a wide range of techniques and sources of inspiration. Gauge theory, symplectic geometry, pseudoholomorphic curves, singularity theory, moduli spaces, braid groups, monodromy, in addition to classical topology and algebraic geometry, combine to make this one of the most vibrant and active areas of research in mathematics. It is our hope that the five lectures of the present volume given at the C.I.M.E. Summer School held in Cetraro, Italy, September 2-10, 2003 will be useful to people working in related areas of mathematics and will become standard references on these topics. The volume is a coherent exposition of an active field of current research focusing on the introduction of new methods for the study of moduli spaces of complex structures on algebraic surfaces, and for the investigation of symplectic topology in dimension 4 and higher.

Real Methods in Complex and CR Geometry - Marco Abate 2004-08-30

The geometry of real submanifolds in complex manifolds and the analysis of their mappings belong to the most advanced streams of contemporary Mathematics. In this area converge the techniques of various and sophisticated mathematical fields such as P.D.E.s, boundary value problems, induced equations, analytic discs in symplectic spaces, complex dynamics. For the variety of themes and the surprisingly good interplaying of different research tools, these problems attracted the attention of some among the best mathematicians of these latest two decades. They also entered as a refined content of an advanced education. In this sense the five lectures of this volume provide an excellent cultural background while giving very deep insights of current research activity.

Holomorphic Dynamical Systems - Nessim Sibony 2010-07-20

The theory of holomorphic dynamical systems is a subject of increasing interest in mathematics, both for its challenging problems and for its connections with other branches of pure and applied mathematics. A holomorphic dynamical system is the datum of a complex variety and a holomorphic object (such as a self-map or a vector ?eld) acting on it. The study of a holomorphic dynamical system consists in describing the asymptotic behavior of the system, associating it with some invariant objects (easy to compute) which describe the dynamics and classify the possible holomorphic dynamical systems supported by a given manifold. The behavior of a holomorphic dynamical system is pretty much related to the geometry of the ambient manifold (for instance, - perbolic manifolds do no admit chaotic behavior, while projective manifolds have a variety of different chaotic pictures). The techniques used to tackle such pr- lems are of variouskinds: complexanalysis, methodsof real analysis, pluripotential theory, algebraic geometry, differential geometry,

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topology. To cover all the possible points of view of the subject in a unique occasion has become almost impossible, and the CIME session in Cetraro on Holomorphic Dynamical Systems was not an exception.

Stochastic Geometry - W. Weil 2006-10-26

Stochastic Geometry is the mathematical discipline which studies mathematical models for random geometric structures. This book collects lectures presented at the CIME summer school in Martina Franca in September 2004. The main lecturers covered Spatial Statistics, Random Points, Integral Geometry and Random Sets. These are complemented by two additional contributions on Random Mosaics and Crystallization Processes. The book presents a comprehensive and up-to-date description of important aspects of Stochastic Geometry.

The Global Theory of Minimal Surfaces in Flat Spaces - W.H. III Meeks 2004-10-11

In the second half of the twentieth century the global theory of minimal surface in flat space had an unexpected and rapid blossoming. Some of the classical problems were solved and new classes of minimal surfaces found. Minimal surfaces are now studied from several different viewpoints using methods and techniques from analysis (real and complex), topology and geometry. In this lecture course, Meeks, Ros and Rosenberg, three of the main architects of the modern edifice, present some of the more recent methods and developments of the theory. The topics include moduli, asymptotic geometry and surfaces of constant mean curvature in the hyperbolic space.

Stochastic Methods in Finance - Kerry Back 2004-11-15

This volume includes the five lecture courses given at the CIME-EMS School on "Stochastic Methods in Finance" held in Bressanone/Brixen, Italy 2003. It deals with innovative methods, mainly from stochastic analysis, that play a fundamental role in the mathematical modelling of finance and insurance: the theory of stochastic processes, optimal and stochastic control, stochastic differential equations, convex analysis and duality theory. Five topics are treated in detail: Utility maximization in incomplete markets; the theory of nonlinear expectations and its relationship with the theory of risk measures in a dynamic setting; credit risk modelling; the interplay between finance and insurance; incomplete information in the context of economic equilibrium and insider trading.

Quantum Transport - Grégoire Allaire 2008-07-03

In this volume, a result of The CIME Summer School held in Cetraro, Italy, in 2006, four leading specialists present different aspects of quantum transport modeling. It provides an excellent basis for researchers in this field.

Lectures on Topological Fluid Mechanics - Mitchell A. Berger 2009-05-05

This volume contains a wide-ranging collection of valuable research papers written by some of the most eminent experts in the field. Topics range from fundamental aspects of mathematical fluid mechanics to DNA tangles and knotted DNAs in sedimentation.

Inverse Problems and Imaging - Luis L. Bonilla 2009-06-19

Nowadays we are facing numerous and important imaging problems: nondestructive testing of materials, monitoring of industrial processes, enhancement of oil production by efficient reservoir characterization, emerging developments in noninvasive imaging techniques for medical purposes - computerized tomography (CT), magnetic resonance imaging (MRI), positron emission tomography (PET), X-ray and ultrasound tomography, etc. In the CIME Summer School on Imaging (Martina Franca, Italy 2002), leading experts in mathematical techniques and applications presented broad and useful introductions for non-experts and practitioners alike to many aspects of this exciting field. The volume contains part of the above lectures completed and updated by additional contributions on other related topics.

Mathematical Foundation of Turbulent Viscous Flows - P. Constantin 2006-01-10

Constantin presents the Euler equations of ideal incompressible fluids and the blow-up problem for the Navier-Stokes equations of viscous fluids, describing major mathematical questions of turbulence theory. These are connected to the Caffarelli-Kohn-Nirenberg theory of singularities for the incompressible Navier-Stokes equations, explained in Gallavotti's lectures. Kazhikhov introduces the theory of strong approximation of weak limits via the method of averaging, applied to Navier-Stokes equations. Y. Meyer focuses on nonlinear evolution equations and related unexpected cancellation properties, either imposed on the initial condition, or satisfied by the solution itself, localized in space or in time variable. Ukai discusses the asymptotic analysis theory of fluid equations, the Cauchy-Kovalevskaya technique for the Boltzmann-Grad limit of the Newtonian equation, the multi-scale analysis, giving compressible and incompressible limits of the Boltzmann equation, and the analysis of their initial layers.

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