Nonlinear Analysis

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From Theory to Application
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Nonlinear Analysis - Theory and Methods
An Introduction to Nonlinear Analysis: Theory

MOLLY MCCULLOUGH

Topics in Nonlinear Analysis & Applications
Springer Science & Business Media

This book develops methods which explore some new interconnections and interrelations between Analysis and Topology and their applications. Emphasis is given to several recent results

which have been obtained mainly during the last years and which cannot be found in other books in Nonlinear Analysis. Interest in this subject area has rapidly increased over the last decade, yet the presentation of research has been confined mainly to journal articles.

Nonlinear Functional Analysis and Its Applications Springer Science & Business Media

Periodic solutions of semilinear parabolic equations. Linear maximal monotone operators and singular nonlinear integral equations of hammerstein type. Nonlinear problems across a point of resonance for non-self-adjoint systems. Branching of periodic solutions of nonautonomous systems. Restricted generic bifurcation. On a second-order nonlinear elliptic boundary value problem. Tikhonov regularization and nonlinear problems at resonance - deterministic and random. The eigenvalue problem for variational inequalities and a new version of the ljusternik-schnirelmann theory. Nonlinear boundary value problems for ordinary differential equations: from schauder theorem to stable homotopy. Some minimax theorems and applications to nonlinear partial differential equations. Branching and stability for nonlinear gradient operators. Recent

progress in bifurcation theory. On the subgradient of convex functionals. On the stability of bifurcating solutions.

Nonlinear Analysis

Springer Science & Business Media

Many of our daily-life problems can be written in the form of an optimization problem. Therefore, solution methods are needed to solve such problems. Due to the complexity of the problems, it is not always easy to find the exact solution. However, approximate solutions can be found. The theory of the best approximation is applicable in a variety of problems arising in nonlinear functional analysis and optimization. This book highlights interesting aspects of nonlinear analysis and optimization together with many applications in the areas of physical and social sciences including engineering. It is immensely helpful for young graduates and researchers who are pursuing research in this field, as it provides abundant research resources for researchers and post-doctoral fellows. This will be a valuable addition to the library of anyone who works in the field of applied mathematics, economics and engineering.

Nonlinear Analysis and Variational Problems

Birkhäuser

An Introduction to Nonlinear Analysis: Theory is an overview of some basic, important aspects of Nonlinear Analysis, with an emphasis on

those not included in the classical treatment of the field. Today Nonlinear Analysis is a very prolific part of modern mathematical analysis, with fascinating theory and many different applications ranging from mathematical physics and engineering to social sciences and economics. Topics covered in this book include the necessary background material from topology, measure theory and functional analysis (Banach space theory). The text also deals with multivalued analysis and basic features of nonsmooth analysis, providing a solid background for the more applications-oriented material of the book An Introduction to Nonlinear Analysis: Applications by the same authors. The book is self-contained and accessible to the newcomer, complete with numerous examples, exercises and solutions. It is a valuable tool, not only for specialists in the field interested in technical details, but also for scientists entering Nonlinear Analysis in search of promising directions for research.

Nonlinear Analysis and Control of Physical Processes and Fields

Springer Science & Business Media

Applied Nonlinear Analysis contains the proceedings of an International Conference on Applied Nonlinear Analysis, held at the University of Texas at Arlington, on April 20-22, 1978.

The papers explore advances in applied nonlinear analysis, with emphasis on reaction-diffusion equations; optimization theory; constructive techniques in numerical analysis; and applications to physical and life sciences. In the area of reaction-diffusion equations, the discussions focus on nonlinear oscillations; rotating spiral waves; stability and asymptotic behavior; discrete-time models in population genetics; and predator-prey systems. In optimization theory, the following topics are considered: inverse and ill-posed problems with application to geophysics; conjugate gradients; and quasi-Newton methods with applications to large-scale optimization; sequential conjugate gradient-restoration algorithm for optimal control problems with non-differentiable constraints; differential geometric methods in nonlinear programming; and equilibria in policy formation games with random voting. In the area of constructive techniques in numerical analysis, numerical and approximate solutions of boundary value problems for ordinary and partial differential equations are examined, along with finite element analysis and constructive techniques for accretive and monotone operators. In addition, the book explores turbulent fluid flows; stability problems for Hopf

bifurcation; product integral representation of Volterra equations with delay; weak solutions of variational problems, nonlinear integration on measures; and fixed point theory. This monograph will be helpful to students, practitioners, and researchers in the field of mathematics.

Methods of Nonlinear Analysis

World Scientific

This book presents an extensive collection of state-of-the-art results and references in nonlinear functional analysis demonstrating how the generic approach proves to be very useful in solving many interesting and important problems. Nonlinear analysis plays an ever-increasing role in theoretical and applied mathematics, as well as in many other areas of science such as engineering, statistics, computer science, economics, finance, and medicine. The text may be used as supplementary material for graduate courses in nonlinear functional analysis, optimization theory and approximation theory, and is a treasure trove for instructors, researchers, and practitioners in mathematics and in the mathematical sciences. Each chapter is self-contained; proofs are solid and carefully communicated. Genericity in Nonlinear Analysis is the first book to systematically present the generic approach to nonlinear analysis. Topics

presented include convergence analysis of powers and infinite products via the Baire Category Theorem, fixed point theory of both single- and set-valued mappings, best approximation problems, discrete and continuous descent methods for minimization in a general Banach space, and the structure of minimal energy configurations with rational numbers in the Aubry–Mather theory.
Genericity in Nonlinear Analysis Springer Science & Business Media
Applied mathematics is a central connecting link between scientific observations and their theoretical interpretation. Nonlinear analysis has surely contributed major developments which nowadays shape the face of applied mathematics. At the beginning of the millennium, all sciences are expanding at increased speed. Technological, ecological, economical and medical problem solving is a central issue of every modern society. Mathematical models help to expose fundamental structures hidden in these problems and serve as unifying tools to deepen our understanding. What are the new challenges applied mathematics has to face with the increased diversity of scientific problems? In which direction should the classical tools of nonlinear analysis be developed further? How do new available technologies influence the development of the

field? How can problems be solved which have been beyond reach in former times? It is the aim of this book to explore new developments in the field by way of discussion of selected topics from nonlinear analysis.

Recent Trends in Nonlinear Analysis Frontiers Media SA

This is an elementary and self-contained introduction to nonlinear functional analysis and its applications, especially in bifurcation theory.

Nonlinear Analysis IGI Global

Although nonlinear dynamics have been mastered by physicists and mathematicians for a long time (as most physical systems are inherently nonlinear in nature), the recent successful application of nonlinear methods to modeling and predicting several evolutionary, ecological, physiological, and biochemical processes has generated great interest and enthusiasm among researchers in computational neuroscience and cognitive psychology. Additionally, in the last years it has been demonstrated that nonlinear analysis can be successfully used to model not only basic cellular and molecular data but also complex cognitive processes and behavioral interactions. The theoretical features of nonlinear systems (such unstable periodic orbits, period-doubling bifurcations and phase space dynamics) have already been

successfully applied by several research groups to analyze the behavior of a variety of neuronal and cognitive processes. Additionally the concept of strange attractors has lead to a new understanding of information processing which considers higher cognitive functions (such as language, attention, memory and decision making) as complex systems emerging from the dynamic interaction between parallel streams of information flowing between highly interconnected neuronal clusters organized in a widely distributed circuit and modulated by key central nodes. Furthermore, the paradigm of self-organization derived from the nonlinear dynamics theory has offered an interesting account of the phenomenon of emergence of new complex cognitive structures from random and non-deterministic patterns, similarly to what has been previously observed in nonlinear studies of fluid dynamics. Finally, the challenges of coupling massive amount of data related to brain function generated from new research fields in experimental neuroscience (such as magnetoencephalography, optogenetics and single-cell intra-operative recordings of neuronal activity) have generated the necessity of new research strategies which incorporate complex pattern analysis as an important feature of

their algorithms. Up to now nonlinear dynamics has already been successfully employed to model both basic single and multiple neurons activity (such as single-cell firing patterns, neural networks synchronization, autonomic activity, electroencephalographic measurements, and noise modulation in the cerebellum), as well as higher cognitive functions and complex psychiatric disorders. Similarly, previous experimental studies have suggested that several cognitive functions can be successfully modeled with basis on the transient activity of large-scale brain networks in the presence of noise. Such studies have demonstrated that it is possible to represent typical decision-making paradigms of neuroeconomics by dynamic models governed by ordinary differential equations with a finite number of possibilities at the decision points and basic heuristic rules which incorporate variable degrees of uncertainty. This e-book has include frontline research in computational neuroscience and cognitive psychology involving applications of nonlinear analysis, especially regarding the representation and modeling of complex neural and cognitive systems. Several experts teams around the world have provided frontline theoretical and experimental contributions (as well

as reviews, perspectives and commentaries) in the fields of nonlinear modeling of cognitive systems, chaotic dynamics in computational neuroscience, fractal analysis of biological brain data, nonlinear dynamics in neural networks research, nonlinear and fuzzy logics in complex neural systems, nonlinear analysis of psychiatric disorders and dynamic modeling of sensorimotor coordination. Rather than a comprehensive compilation of the possible topics in neuroscience and cognitive research to which non-linear may be used, this e-book intends to provide some illustrative examples of the broad range of

Nonlinear Analysis for Human Movement Variability Springer This contributed volume showcases research and survey papers devoted to a broad range of topics on functional equations, ordinary differential equations, partial differential equations, stochastic differential equations, optimization theory, network games, generalized Nash equilibria, critical point theory, calculus of variations, nonlinear functional analysis, convex analysis, variational inequalities, topology, global differential geometry, curvature flows, perturbation theory, numerical analysis, mathematical finance and a variety of applications in interdisciplinary topics.

Chapters in this volume investigate compound superquadratic functions, the Hyers–Ulam Stability of functional equations, edge degenerate pseudo-hyperbolic equations, Kirchhoff wave equation, BMO norms of operators on differential forms, equilibrium points of the perturbed R3BP, complex zeros of solutions to second order differential equations, a higher-order Ginzburg–Landau-type equation, multi-symplectic numerical schemes for differential equations, the Erdős-Rényi network model, strongly m-convex functions, higher order strongly generalized convex functions, factorization and solution of second order differential equations, generalized topologically open sets in relator spaces, graphical mean curvature flow, critical point theory in infinite dimensional spaces using the Leray-Schauder index, non-radial solutions of a supercritical equation in expanding domains, the semi-discrete method for the approximation of the solution of stochastic differential equations, homotopic metric-interval L-contractions in gauge spaces, Rhoades contractions theory, network centrality measures, the Radon transform in three space dimensions via plane integration and applications in positron emission tomography boundary perturbations on medical monitoring

and imaging techniques, the KdV-B equation and biomedical applications.

Nonlinear Analysis and Synthesis Techniques for Aircraft Control American Mathematical Soc.

This book consists of nine papers covering a number of basic ideas, concepts, and methods of nonlinear analysis, as well as some current research problems. Thus, the reader is introduced to the fascinating theory around Brouwer's fixed point theorem, to Granas' theory of topological transversality, and to some advanced techniques of critical point theory and fixed point theory. Other topics include discontinuous differential equations, new results of metric fixed point theory, robust tracker design problems for various classes of nonlinear systems, and periodic solutions in computer virus propagation models.

An Introduction to Nonlinear Analysis: Theory CRC Press

Modern achievements in the intensively developing field of applied mathematics are presented in this monograph. In particular, it proposes a new approach to extremal problem theory for nonlinear operators, differential-operator equations and inclusions, and for variational inequalities in Banach spaces. An axiomatic study of nonlinear maps (including multi-valued ones) is given, and the

properties of resolving operators for systems, consisting of operator and differential-operator equations, are stated in nonlinear-map terms. The solvability conditions and the properties of extremal problem solutions are obtained, while their weak expansions and necessary conditions of optimality in variational inequality form are formulated. In addition. the monograph proposes regularization methods and approximation schemes. This book is adressed to scientists, graduates and undergraduates who are interested in nonlinear analysis, control theory, system analysis and differential equations. *A Primer of Nonlinear Analysis* Springer Herbert Amann's work is distinguished and marked by great lucidity and deep mathematical understanding. The present collection of 31 research papers, written by highly distinguished and accomplished mathematicians, reflect his interest and lasting influence in various fields of analysis such as degree and fixed point theory, nonlinear elliptic boundary value problems, abstract evolutions equations, quasi-linear parabolic systems, fluid dynamics, Fourier analysis, and the theory of function spaces. Contributors are A. Ambrosetti, S. Angenent, W. Arendt, M. Badiale, T. Bartsch, Ph. Bénilan, Ph. Clément, E.

Faöangová, M. Fila, D. de Figueiredo, G. Gripenberg, G. Da Prato, E.N. Dancer, D. Daners, E. DiBenedetto, D.J. Diller, J. Escher, G.P. Galdi, Y. Giga, T. Hagen, D.D. Hai, M. Hieber, H. Hofer, C. Imbusch, K. Ito, P. Krejcí, S.-O. Londen, A. Lunardi, T. Miyakawa, P. Quittner, J. Prüss, V.V. Pukhnachov, P.J. Rabier, P.H. Rabinowitz, M. Renardy, B. Scarpellini, B.J. Schmitt, K. Schmitt, G. Simonett, H. Sohr, V.A. Solonnikov, J. Sprekels, M. Struwe, H. Triebel, W. von Wahl, M. Wiegner, K. Wysocki, E. Zehnder and S. Zheng. *Nonlinear Analysis and its Applications to Differential Equations* Springer Science & Business Media

This paper is concerned with the existence and uniform decay rates of solutions of the waveequation with a sourceterm and subject to nonlinear boundary damping ? ? u ?? u =|u| u in ? ×(0,+?) ? tt ? ? ? ? u=0 on ? ×(0,+?) 0 (1. 1) ? ? u+g(u)=0 on ? ×(0,+?) ? t 1 ? ? ? ? 0 1 u(x,0) = u (x); u (x,0) = u (x),x? ? , t n where ? is a bounded domain of R ,n? 1, with a smooth boundary ? = ? ?? . 0 1 Here, ? and ? are closed and disjoint and ? represents the unit outward normal 0 1 to ?. Problems like (1. 1), more precisely, ? u ?? u =?f (u)in? ×(0,+?) ? tt 0 ? ? ? ? u=0 on ? ×(0,+?) 0 (1. 2) ? ? u =?g(u)?f (u)on? ×(0,+?) ? t 1 1 ? ? ? ? 0 1 u(x,0) = u (x); u (x,0) = u (x),x? ? , t were widely studied in the literature, mainly when

f =0,see[6,13,22]anda 1 long list of references therein. When f =0and f = 0 this kind of problem was 0 1 well studied by Lasiecka and Tataru [15] for a very general model of nonlinear functions f (s),i=0,1, but assuming that f (s)s? 0, that is, f represents, for i i i each i, an attractive force.

Fixed Points and Topological Degree in Nonlinear Analysis Springer

The main purpose of the present volume is to give a survey of some of the most significant achievements obtained by topological methods in nonlin ear analysis during the last three decades. It is intended, at least partly, as a continuation of Topological Nonlinear Analysis: Degree, Singularity and Varia tions, published in 1995. The survey articles presented are concerned with three main streams of research, that is topological degree, singularity theory and variational methods, They reflect the personal taste of the authors, all of them well known and distinguished specialists. A common feature of these articles is to start with a historical introduction and conclude with recent results, giving a dynamic picture of the state of the art on these topics. Let us mention the fact that most of the materials in this book were pre sented by the authors at the "Second Topological Analysis Workshop on Degree, Singularity and

Variations: Developments of the Last 25 Years," held in June 1995 at Villa Tuscolana, Frascati, near Rome. Michele Matzeu Alfonso Vignoli Editors Topological Nonlinear Analysis II Degree, Singularity and Variations Classical Solutions for a Perturbed N-Body System Gianfausto Dell 'A ntonio O. Introduction In this review I shall consider the perturbed N-body system, i.e., a system composed of N point bodies of masses ml, ... mN, described in cartesian co ordinates by the system of equations (0.1) where f) V'k,m == -£l--' m = 1, 2, 3.

Nonlinear Analysis on Manifolds, Monge-Ampère Equations Springer Science & Business Media

This book is meant as a present to honor Professor on the th occasion of his 70 birthday. It collects refereed contributions from sixty-one mathematicians from eleven countries. They cover many different areas of research related to the work of Professor including Navier-Stokes equations, nonlinear elasticity, non-Newtonian fluids, regularity of solutions of parabolic and elliptic problems, operator theory and numerical methods. The realization of this book could not have been made possible without the generous support of Centro de Matemática Aplicada (CMA/IST) and Fundação Calouste Gulbenkian. Special thanks are due to Dr.

Ulrych for the careful preparation of the final version of this book. Last but not least, we wish to express our gratitude to Dr. for her invaluable assistance from the very beginning. This project could not have been successfully concluded without her enthusiasm and loving care for her father. On behalf of the editors ADÉLIA SEQUEIRA v honored by the Order of Merit of the Czech Republic by Václav Havel, President of the Czech Republic, on the October 28, 1998, Professor Emeritus of Mathematics at the Charles University in Prague, Presidential Research Professor at the Northern Illinois University and Doctor Honoris Causa at the Technical University of Dresden, has been enriching the Czech and world mathematics with his new ideas in the areas of partial differential equations, nonlinear functional analysis and applications of the both disciplines in continuum mechanics and hydrodynamics for more than forty years.

Recent Advances in Nonlinear Analysis and Optimization with Applications

Cambridge Scholars Publishing

This well-thought-out book covers the fundamentals of nonlinear analysis, with a particular focus on variational methods and their applications. Starting from preliminaries in functional analysis, it expands in several directions such as Banach spaces, fixed point theory,

nonsmooth analysis, minimax theory, variational calculus and inequalities, critical point theory, monotone, maximal monotone and pseudomonotone operators, and evolution problems.
Nonlinear Analysis Cambridge University Press
This book offers a systematic presentation of up-to-date material scattered throughout the literature from the methodology point of view. It reviews the basic theories and methods, with many interesting problems in partial and ordinary differential equations, differential geometry and mathematical physics as applications, and provides the necessary preparation for almost all important aspects in contemporary studies. All methods are illustrated by carefully chosen examples from mechanics, physics, engineering and geometry.
Trends in Nonlinear Analysis Springer Science & Business Media
How Does the Body’s Motor Control System Deal with Repetition? While the presence of nonlinear dynamics can be explained and understood, it is difficult to be measured. A study of human movement variability with a focus on nonlinear dynamics, Nonlinear Analysis for Human Movement Variability, examines the characteristics of human movement within this framework, explores human movement in

repetition, and explains how and why we analyze human movement data. It takes an in-depth look into the nonlinear dynamics of systems within and around us, investigates the temporal structure of variability, and discusses the properties of chaos and fractals as they relate to human movement. Providing a foundation for the use of nonlinear analysis and the study of movement variability in practice, the book describes the nonlinear dynamical features found in complex biological and physical systems, and introduces key concepts that help determine and identify patterns within the fluctuations of data that are repeated over time. It presents commonly used methods and novel approaches to movement analysis that reveal intriguing properties of the motor control system and introduce new ways of thinking about variability, adaptability, health, and motor learning. In addition, this text: Demonstrates how nonlinear measures can be used in a variety of different tasks and populations Presents a wide variety of nonlinear tools such as the Lyapunov exponent, surrogation, entropy, and fractal analysis Includes examples from research on how nonlinear analysis can be used to understand real-world applications Provides numerous case studies in postural control, gait, motor control, and motor

development Nonlinear Analysis for Human Movement Variability advances the field of human movement variability research by dissecting human movement and studying the role of movement variability. The book proposes new ways to use nonlinear analysis and investigate the temporal structure of variability, and enables engineers, movement scientists, clinicians, and those in related disciplines to effectively apply nonlinear analysis in practice.

Variational Methods in Nonlinear Analysis Elsevier

The field of computational sciences has seen a considerable development in mathematics, engineering sciences, and economic equilibrium theory. Researchers in this field are faced with the problem of solving a variety of equations or variational inequalities. We note that in computational sciences, the practice of numerical analysis for finding such solutions is essentially connected to variants of Newton's method. The efficient computational methods for finding the solutions of fixed point problems, nonlinear equations and variational inclusions are the first goal of the present book. The second goal is the applications of these methods in nonlinear problems and the connection with fixed point theory. This book is intended for

researchers in computational sciences, and as a reference book for an advanced computational methods in nonlinear analysis. We collect the recent results on the convergence analysis of numerical algorithms in both finite-dimensional and infinite-dimensional spaces, and present several applications and connections with fixed point theory. The book contains abundant and updated bibliography, and provides comparison between various investigations made in recent years in the field of computational nonlinear analysis.