Equilibrium Solutions And Stability Differential Equations

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Applications of Centre Manifold Theory Springer Calculus is designed for the typical two- or three-semester general calculus course, incorporating innovative features to enhance student learning. The book guides students through the core concepts of calculus and helps them understand how those concepts apply to their lives and the world around them. Due to the comprehensive nature of the material, we are offering the book in three volumes for flexibility and efficiency. Volume 3 covers parametric equations and polar coordinates, vectors, functions of several variables, multiple integration, and second-order differential equations.

An Introduction To Nonautonomous Dynamical Systems And Their Attractors Princeton University Press This monograph provides a definitive overview of recent advances in the stability and oscillation of autonomous delay differential equations. Topics include linear and nonlinear delay and integrodifferential equations, which have potential applications to both biological and physical dynamic processes. Chapter 1 deals with an analysis of the dynamical characteristics of the delay logistic equation, and a number of techniques and results relating to stability, oscillation and comparison of scalar delay and integrodifferential equations are presented. Chapter 2 provides a tutorial-style introduction to the study of delay-induced Hopf bifurcation to periodicity and the related computations for the analysis of the stability of bifurcating periodic solutions. Chapter 3 is devoted to local analyses of nonlinear model systems and discusses many methods applicable to linear equations and their perturbations. Chapter 4 considers global convergence to equilibrium states of nonlinear systems, and includes

oscillations of nonlinear systems about their equilibria. Qualitative analyses of both competitive and cooperative systems with time delays feature in both Chapters 3 and 4. Finally, Chapter 5 deals with recent developments in models of neutral differential equations and their applications to population dynamics. Each chapter concludes with a number of exercises and the overall exposition recommends this volume as a good supplementary text for graduate courses. For mathematicians whose work involves functional differential equations, and whose interest extends beyond the boundaries of linear stability analysis.

A First Course in Differential Equations SIAM

Dynamical Systems for Biological Modeling: An Introduction prepares both biology and mathematics students with the understanding and techniques necessary to undertake basic modeling of biological systems. It achieves this through the development and analysis of dynamical systems.The approach emphasizes qualitative ideas rather than explicit computa

A Modern Introduction to Differential Equations Springer Science & Business Media

The book serves both as a reference for various scaled models with corresponding dimensionless numbers, and as a resource for learning the art of scaling. A special feature of the book is the emphasis on how to create software for scaled models, based on existing software for unscaled models. Scaling (or non-dimensionalization) is a mathematical technique that greatly simplifies the setting of input parameters in numerical simulations. Moreover, scaling enhances the understanding of how different physical processes interact in a differential equation model. Compared to the existing literature, where the topic of scaling is frequently encountered, but very often in only a brief and shallow setting, the present book gives much more thorough explanations of how to reason about finding the right scales. This process is highly problem dependent, and therefore the book features a lot of worked examples, from very simple ODEs to systems of PDEs, especially from fluid mechanics. The text is easily accessible and example-driven. The first part on ODEs fits even a lower undergraduate level, while the most advanced multiphysics fluid mechanics examples target the graduate level. The scientific literature is full of scaled models, but in most of the cases, the scales are just stated without thorough mathematical reasoning. This book explains how the scales are found mathematically. This book will be a valuable read for anyone doing numerical simulations based on ordinary or partial differential equations.

Differential Equations and Boundary Value Problems Routledge

Fractional calculus was first developed by pure mathematicians in the middle of the 19th century. Some 100 years later, engineers and physicists have found applications for these concepts in their areas. However there has traditionally been little interaction between these two communities. In particular, typical mathematical works provide extensive findings on aspects with comparatively little significance in applications, and the engineering literature often lacks mathematical detail and precision. This book bridges the gap between the two communities. It concentrates on the class of fractional derivatives most important in applications, the Caputo operators, and provides a self-contained, thorough and mathematically rigorous study of their properties and of the corresponding differential equations. The text is a useful tool for mathematicians and researchers from the applied sciences alike. It can also be used as a basis for teaching graduate courses on

fractional differential equations.

The Analysis of Fractional Differential Equations Courier Dover Publications Nonlinear difference equations of order greater than one are of paramount impor tance in applications where the (n + 1)st generation (or state) of the system depends on the previous k generations (or states). Such equations also appear naturally as discrete analogues and as numerical solutions of differential and delay differential equations which model various diverse phenomena in biology, ecology, physiology, physics, engineering and economics. Our aim in this monograph is to initiate a systematic study of the global behavior of solutions of nonlinear scalar difference equations of order greater than one. Our primary concern is to study the global asymptotic stability of the equilibrium solution. We are also interested in whether the solutions are bounded away from zero and infinity, in the description of the semi cycles of the solutions, and in the existence of periodic solutions. This monograph contains some recent important developments in this area together with some applications to mathematical biology. Our intention is to expose the reader to the frontiers of the subject and to formulate some important open problems that require our immediate attention.

Differential Equations and Linear Algebra CRC Press A Modern Introduction to Differential Equations, Third Edition, provides an introduction to the basic concepts of differential equations. The book begins by introducing the basic concepts of differential equations, focusing on the analytical, graphical and numerical aspects of first-order equations, including slope fields and phase lines. The comprehensive resource then covers methods of solving second-order homogeneous and nonhomogeneous linear equations with constant coefficients, systems of linear differential equations, the Laplace transform and its applications to the solution of differential equations and systems of differential equations, and systems of nonlinear equations. Throughout the text, valuable pedagogical features support learning and teaching. Each chapter concludes with a summary of important concepts, and figures and tables are provided to help students visualize or summarize concepts. The book also includes examples and updated exercises drawn from biology, chemistry, and economics, as well as from traditional pure mathematics, physics, and engineering. - Offers an accessible and highly readable resource to engage students - Introduces qualitative and numerical methods early to build understanding - Includes a large number of exercises from biology, chemistry, economics, physics and engineering - Provides exercises that are labeled based on difficulty/sophistication and end-of-chapter summaries

Calculus Volume - 2 Wellesley-Cambridge Press In the last few decades the theory of ordinary differential equations has grown rapidly under the action of forces which have been working both from within and without: from within, as a development and deepen ing of the concepts and of the topological and analytical methods brought about by LYAPUNOV, POINCARE, BENDIXSON, and a few others at the turn of the century; from without, in the wake of the technological development, particularly in communications, servomechanisms, auto matic controls, and electronics. The early research of the authors just mentioned lay in challenging problems of astronomy, but the line of thought thus produced found the most impressive applications in the new fields. The body of research now accumulated is overwhelming, and many

books and reports have appeared on one or another of the multiple aspects of the new line of research which some authors call "qualitative theory of differential equations". The purpose of the present volume is to present many of the view points and questions in a readable short report for which completeness is not claimed. The bibliographical notes in each section are intended to be a guide to more detailed expositions and to the original papers. Some traditional topics such as the Sturm comparison theory have been omitted. Also excluded were all those papers, dealing with special differential equations motivated by and intended for the applications.

Introduction to Hamiltonian Fluid Dynamics and Stability Theory Springer Science & Business Media

A practical and concise guide to finite difference and finite element methods. Well-tested MATLAB ® codes are available online.

Nonlinear Dynamics Createspace Independent Publishing Platform

This textbook is a unique blend of the theory of differential equations and their exciting application to "real world" problems. First, and foremost, it is a rigorous study of ordinary differential equations and can be fully un derstood by anyone who has completed one year of calculus. However, in addition to the traditional applications, it also contains many exciting "real life" problems. These applications are completely self contained. First, the problem to be solved is outlined clearly, and one or more differential equa tions are derived as a model for this problem. These equations are then solved, and the results are compared with real world data. The following applications are covered in this text. I. In Section 1.3 we prove that the beautiful painting "Disciples of Emmaus" which was bought by the Rembrandt Society of Belgium for $170,000 was a modem forgery. 2. In Section 1.5 we derive differential equations which govern the population growth of various species, and compare the results predicted by our models with the known values of the populations. 3. In Section 1.6 we derive differential equations which govern the rate at which farmers adopt new innovations. Surprisingly, these same differen tial equations govern the rate at which technological innovations are adopted in such diverse industries as coal, iron and steel, brewing, and railroads.

Active Calculus 2018 Springer

Differential equations are the basis for models of any physical systems that exhibit smooth change. This book combines much of the material found in a traditional course on ordinary differential equations with an introduction to the more modern theory of dynamical systems. Applications of this theory to physics, biology, chemistry, and engineering are shown through examples in such areas as population modeling, fluid dynamics, electronics, and mechanics. Differential Dynamical Systems begins with coverage of linear systems, including matrix algebra; the focus then shifts to foundational material on nonlinear differential equations, making heavy use of the contraction-mapping theorem. Subsequent chapters deal specifically with dynamical systems concepts?flow, stability, invariant manifolds, the phase plane, bifurcation, chaos, and Hamiltonian dynamics. This new edition contains several important updates and revisions throughout the book. Throughout the book, the author includes exercises to help students

develop an analytical and geometrical understanding of dynamics. Many of the exercises and examples are based on applications and some involve computation; an appendix offers simple codes written in Maple, Mathematica, and MATLAB software to give students practice with computation applied to dynamical systems problems.

Ordinary Differential Equations and Dynamical Systems American Mathematical Society

Mathematical Modelling with Case Studies: Using Maple and MATLAB, Third Edition provides students with hands-on modelling skills for a wide variety of problems involving differential equations that describe rates of change. While the book focuses on growth and decay processes, interacting populations, and heating/cooling problems, the mathematical

Notes on Diffy Qs McGraw Hill

Students who have used Smith/Minton's Calculus say it was easier to read than any other math book they've used. That testimony underscores the success of the authors ' approach, which combines the best elements of reform with the most reliable aspects of mainstream calculus teaching, resulting in a motivating, challenging book. Smith/Minton also provide exceptional, reality-based applications that appeal to students ' interests and demonstrate the elegance of math in the world around us. New features include: • A new organization placing all transcendental functions early in the book and consolidating the introduction to L'H ô pital's Rule in a single section. • More concisely written explanations in every chapter. • Many new exercises (for a total of 7,000 throughout the book) that require additional rigor not found in the 2nd Edition. • New exploratory exercises in every section that challenge students to synthesize key concepts to solve intriguing projects. • New commentaries (" Beyond Formulas ") that encourage students to think mathematically beyond the procedures they learn. • New counterpoints to the historical notes, " Today in Mathematics, " that stress the contemporary dynamism of mathematical research and applications, connecting past contributions to the present. • An enhanced discussion of differential equations and additional applications of vector calculus.

Stability and Oscillations in Delay Differential Equations of Population Dynamics Springer Science & Business Media

The nature of time in a nonautonomous dynamical system is very different from that in autonomous systems, which depend only on the time that has elapsed since starting rather than on the actual time itself. Consequently, limiting objects may not exist in actual time as in autonomous systems. New concepts of attractors in nonautonomous dynamical system are thus required.In addition, the definition of a dynamical system itself needs to be generalised to the nonautonomous context. Here two possibilities are considered: two-parameter semigroups or processes and the

skew product flows. Their attractors are defined in terms of families of sets that are mapped onto each other under the dynamics rather than a single set as in autonomous systems. Two types of attraction are now possible: pullback attraction, which depends on the behaviour from the system in the distant past, and forward attraction, which depends on the behaviour of the system in the distant future. These are generally independent of each other.The component subsets of pullback and forward attractors exist in actual time. The asymptotic behaviour in the future limit is characterised by omega-limit sets, in terms of which form what are called forward attracting sets. They are generally not invariant in the conventional sense, but are asymptotically invariant in general and, if the future dynamics is appropriately uniform, also asymptotically negatively invariant.Much of this book is based on lectures given by the authors in Frankfurt and Wuhan. It was written mainly when the first author held a 'Thousand Expert' Professorship at the Huazhong University of Science and Technology in Wuhan.

EBOOK: Calculus: Early Transcendental Functions SIAM

The statics and mechanics of structures form a core aspect of civil engineering. This book provides an introduction to the subject, starting from classic hand-calculation types of analysis and gradually advancing to a systematic form suitable for computer implementation. It starts with statically determinate structures in the form of trusses, beams and frames. Instability is discussed in the form of the column problem - both the ideal column and the imperfect column used in actual column design. The theory of statically indeterminate structures is then introduced, and the force and deformation methods are explained and illustrated. An important aspect of the book ' s approach is the systematic development of the theory in a form suitable for computer implementation using finite elements. This development is supported by two small computer programs, MiniTruss and MiniFrame, which permit static analysis of trusses and frames, as well as linearized stability analysis. The book ' s final section presents related strength of materials subjects in greater detail; these include stress and strain, failure criteria, and normal and shear stresses in general beam flexure and in beam torsion. The book is well-suited as a textbook for a two-semester introductory course on structures.

Differential Equations and Their Applications EduGorilla Publication

This book uses a hands-on approach to nonlinear dynamics using commonly available software, including the free dynamical systems software Xppaut, Matlab (or its free cousin, Octave) and the Maple symbolic algebra system. Detailed instructions for various common procedures, including bifurcation analysis using the version of AUTO embedded in Xppaut, are provided. This

book also provides a survey that can be taught in a single academic term covering a greater variety of dynamical systems (discrete versus continuous time, finite versus infinite-dimensional, dissipative versus conservative) than is normally seen in introductory texts. Numerical computation and linear stability analysis are used as unifying themes throughout the book. Despite the emphasis on computer calculations, theory is not neglected, and fundamental concepts from the field of nonlinear dynamics such as solution maps and invariant manifolds are presented.

A textbook on Ordinary Differential Equations Springer Science & Business Media

Mathematics is playing an ever more important role in the physical and biological sciences, provoking a blurring of boundaries between scientific disciplines and a resurgence bf interest in the modern as well as the clas sical techniques of applied mathematics. This renewal of interest, both in research and teaching, has led to the establishment of the series: Texts in Applied Mat!!ematics (TAM). The development of new courses is a natural consequence of a high level of excitement oil the research frontier as newer techniques, such as numerical and symbolic cotnputer systems, dynamical systems, and chaos, mix with and reinforce the traditional methods of applied mathematics. Thus, the purpose of this textbook series is to meet the current and future needs of these advances and encourage the teaching of new courses. TAM will publish textbooks suitable for use in advanced undergraduate and beginning graduate courses, and will complement the Applied Math ematical Sciences (AMS) series, which will focus on advanced textbooks and research level monographs. Preface to the Second Edition This book covers those topics necessary for a clear understanding of the qualitative theory of ordinary differential equations and the concept of a dynamical system. It is written for advanced undergraduates and for beginning graduate students. It begins with a study of linear systems of ordinary differential equations, a topic already familiar to the student who has completed a first course in differential equations.

Statics and Mechanics of Structures Springer

An authoritative treatment by leading researchers covering theory and optimal estimation, along with practical applications.

Differential-difference Equations Cambridge University Press

The book is a primer of the theory of Ordinary Differential Equations. Each chapter is completed by a broad set of exercises; the reader will also find a set of solutions of selected exercises. The book contains many interesting examples as well (like the equations for the electric circuits, the pendulum equation, the logistic equation, the Lotka-Volterra system, and many other) which introduce the reader to some interesting aspects of

the theory and its applications. The work is mainly addressed to students of Mathematics, Physics, Engineering, Statistics, Computer Sciences, with knowledge of Calculus and Linear Algebra, and contains more advanced topics for further developments, such as Laplace transform; Stability theory and existence of solutions to Boundary Value problems. A complete Solutions Manual, containing solutions to all the exercises published in the book, is available. Instructors who wish to adopt the book may request the manual by writing directly to one of the authors.

Fractals and Fractional Calculus in Continuum Mechanics Morgan & Claypool Publishers This book is intended as an alternative to the standard differential equations text, which typically includes a large collection of methods and applications, packaged with state-of-the-art color graphics, student solution manuals, the latest fonts, marginal notes, and web-based supplements. These texts adds up to several hundred pages of text and can be very expensive for students to buy. Many students do not have the time or desire to read voluminous texts and explore internet supplements. Here, however, the author writes concisely, to the point, and in plain language. Many examples and exercises are included. In addition, this text also encourages students to use a computer algebra system to solve problems numerically, and as such, templates of MATLAB programs that solve differential equations are given in an appendix, as well as basic Maple and Mathematica commands.