Numerical Solution Of Singularly Perturbed Problems Using

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The Asymtotic Behavior and Numerical Solution of Singular Perturbation Problems with Turning Points - Fred W. Dorr 1969

Difference Methods for Singular Perturbation Problems - Grigory I. Shishkin 2008-09-22

Difference Methods for Singular Perturbation Problems focuses on the development of robust difference schemes for wide classes of boundary value problems. It justifies the ε-uniform convergence of these schemes and surveys the latest approaches important for

further progress in numerical methods. The first part of the book explores boundary value problems for elliptic and parabolic reaction-diffusion and convection-diffusion equations in n-dimensional domains with smooth and piecewise-smooth boundaries. The authors develop a technique for constructing and justifying ε uniformly convergent difference schemes for boundary value problems with fewer restrictions on the problem data. Containing information published mainly in the last four years, the second section focuses on problems with boundary layers and additional singularities generated by nonsmooth data, unboundedness of the domain, and the perturbation vector parameter. This part also studies both the solution and its derivatives with errors that are independent of the perturbation parameters. Co-authored by the creator of the Shishkin mesh, this book presents a systematic, detailed development of approaches to construct ε uniformly convergent finite difference schemes for broad classes of singularly perturbed boundary value problems.

Numerical Solution of Boundary Value Problems for Ordinary Differential Equations - Uri M. Ascher 1994-12-01

This book is the most comprehensive, up-to-date account of the popular numerical methods for solving boundary value problems in ordinary differential equations. It aims at a thorough understanding of the field by giving an in-depth analysis of the numerical methods by using decoupling principles. Numerous exercises and real-world examples are used throughout to demonstrate the methods and the theory. Although first published in 1988, this republication remains the most comprehensive theoretical coverage of the subject matter, not available elsewhere in one volume. Many problems, arising in a wide variety of application areas, give rise to mathematical models which

form boundary value problems for ordinary differential equations. These problems rarely have a closed form solution, and computer simulation is typically used to obtain their approximate solution. This book discusses methods to carry out such computer simulations in a robust, efficient, and reliable manner.

Numerical Solution of Partial Differential Equations in Science and Engineering - Leon Lapidus 2011-02-14

From the reviews of Numerical Solution of PartialDifferential Equations in Science and Engineering: "The book by Lapidus and Pinder is a very comprehensive, evenexhaustive, survey of the subject . . . [It] is unique in that itcovers equally finite difference and finite element methods." Burrelle's "The authors have selected an elementary (but not simplistic)mode of presentation. Many different computational schemes aredescribed in great detail . . . Numerous practical examples andapplications are described from beginning to the end, often withcalculated results given." Mathematics of Computing "This volume . . . devotes its considerable number of pages tolucid developments of the methods [for solving partial differentialequations] . . . the writing is very polished and I found it apleasure to read!" Mathematics of Computation Of related interest . . . NUMERICAL ANALYSIS FOR APPLIED SCIENCE Myron B. Allen andEli L. Isaacson. A modern, practical look at numerical analysis,this book guides readers through a broad selection of numericalmethods, implementation, and basic theoretical results, with anemphasis on methods used in scientific computation involvingdifferential equations. 1997 (0-471-55266-6) 512 pp. APPLIED MATHEMATICS Second Edition, J. David Logan.Presenting an easily accessible treatment of mathematical methodsfor scientists and engineers, this acclaimed work covers

fluidmechanics and calculus of variations as well as more modernmethods-dimensional analysis and scaling, nonlinear wavepropagation, bifurcation, and singular perturbation. 1996(0-471-16513-1) 496 pp.

Uniform Numerical Methods for Problems with Initial and Boundary Layers - E. P. Doolan 1980

Layer-Adapted Meshes for Reaction-Convection-Diffusion Problems - Torsten Linß 2009-11-21

This is a book on numerical methods for singular perturbation problems – in part- ular, stationary reaction-convection-diffusion problems exhibiting layer behaviour. More precisely, it is devoted to the construction and analysis of layer-adapted meshes underlying these numerical methods. Numerical methods for singularly perturbed differential equations have been studied since the early 1970s and the research frontier has been constantly - panding since. A comprehensive exposition of the state of the art in the analysis of numerical methods for singular perturbation problems is [141] which was p- lished in 2008. As that monograph covers a big variety of numerical methods, it only contains a rather short introduction to layer-adapted meshes, while the present book is exclusively dedicated to that subject. An early important contribution towards the optimisation of numerical methods by means of special meshes was made by N.S. Bakhvalov [18] in 1969. His paper spawned a lively discussion in the literature with a number of further meshes - ing proposed and applied to various singular perturbation problems. However, in the mid 1980s, this development stalled, but was enlivened again by G.I. Shishkin’s proposal of piecewise-equidistant meshes in the early 1990s [121,150]. Because of their very simple structure, they are often much easier to analyse than other meshes, although they give numerical approximations that are inferior to solutions on c-

peting meshes. Shishkin meshes for numerous problems and numerical methods have been studied since and they are still very much in vogue.

Single Perturbation Problems in Chemical Physics - John J. H. Miller 2009-09-09

The Matching Method for Asymptotic Solutions in Chemical Physics Problems by A. M. Il'in, L. A. Kalyakin, and S. I. Maslennikov Singularly Perturbed Problems with Boundary and Interior Layers: Theory and Application by V. F. Butuzov and A. B. Vasilieva Numerical Methods for Singularly Perturbed Boundary Value Problems Modeling Diffusion Processes by V. L. Kolmogorov and G. I. Shishkin An important addition to the Advances in Chemical Physics series, this volume makes available for the first time in English the work of leading Russian researchers in singular perturbation theory and its application. Since boundary layers were first introduced by Prandtl early in this century, rapid advances have been made in the analytic and numerical investigation of these phenomena, and nowhere have these advances been more notable than in the Russian school of singular perturbation theory. The three chapters in this volume treat various aspects of singular perturbations and their numerical solution, and represent some of the best work done in this area: * The first chapter, "The Matching Method for Asymptotic Solutions in Chemical Physics Problems," is concerned with the analysis of some singular perturbation problems that arise in chemical kinetics. In this chapter the matching method is applied to find asymptotic solutions to some dynamical systems of ordinary differential equations whose solutions have multiscale time dependence. * The second chapter, "Singularly Perturbed Problems with Boundary and Interior Layers: Theory and Application," offers a comprehensive overview of the theory and application of asymptotic approximations for

many different kinds of problems in chemical physics governed by either ordinary or partial differential equations with boundary and interior layers. * The third chapter, "Numerical Methods for Singularly Perturbed Boundary Value Problems Modeling Diffusion Processes," discusses the numerical difficulties that arise in solving the problems described in the first two chapters, and proposes rigorous criteria for determining whether or not a numerical method is satisfactory for such problems. Methods satisfying these criteria are then constructed and applied to obtain numerical solutions to a range of sample problems. Timely, authoritative, and invaluable to researchers in all areas of chemical physics, Singular Perturbation Problems in Chemical Physics is an essential resource.

Analytical and Numerical Methods for Convection-dominated and Singularly Perturbed Problems - Lubin Vulkov 2000

This volume is the Proceedings of the Workshop on Analytical and Computational Methods for Convection-Dominated and Singularly Perturbed Problems, which took place in Lozenetz, Bulgaria, 27-31 August 1998. The workshop attracted about 50 participants from 12 countries. The volume includes 13 invited lectures and 19 contributed papers presented at the workshop and thus gives an overview of the latest developments in both the theory and applications of advanced numerical methods to problems having boundary and interior layers. There was an emphasis on experiences from the numerical analysis of such problems and on theoretical developments. The aim of the workshop was to provide an opportunity for scientists from the East and the West, who develop robust methods for singularly perturbed and related problems and also who apply these methods to real-life problems, to discuss recent achievements in this area and to exchange ideas with a view

of possible research co-operation.

Analyzing Multiscale Phenomena Using Singular Perturbation Methods - Jane Cronin 1999

To understand multiscale phenomena, it is essential to employ asymptotic methods to construct approximate solutions and to design effective computational algorithms. This volume consists of articles based on the AMS Short Course in Singular Perturbations held at the annual Joint Mathematics Meetings in Baltimore (MD). Leading experts discussed the following topics which they expand upon in the book: boundary layer theory, matched expansions, multiple scales, geometric theory, computational techniques, and applications in physiology and dynamic metastability. Readers will find that this text offers an up-to-date survey of this important field with numerous references to the current literature, both pure and applied.

The Boundary Function Method for Singular Perturbed Problems - Adelaida B. Vasil'eva 1995-01-01

This is the first book published in English devoted solely to the boundary function method, which is one of the asymptotic methods. This method provides an effective and simple way to obtain asymptotic approximations for the solutions of certain ordinary and partial differential equations containing small parameters in front of the highest derivatives. These equations, called singularly perturbed equations, are often used in modeling. In addition to numerous examples, the book includes discussions on singularly perturbed problems from chemical kinetics and heat conduction, semiconductor device modeling, and mathematical biology. The book also contains a variety of original ideas and explicit calculations previously available only in journal literature, as well as many concrete applied problems illustrating the boundary function method algorithms.

Quite general asymptotic results described in the book are rigorous in the sense that, along with the asymptotic algorithms, in most cases the theorems on estimation of the remainder terms are presented. A survey of results of Russian mathematicians on the subject is provided; many of these results are not well known in the West. Based on the Russian edition of the textbook by Vasil'eva and Butuzov, this American edition, prepared by Kalachev, differs in many aspects. The text of the book has been revised substantially, some new material has been added to every chapter, and more examples, exercises, and new references on asymptotic methods and their applications have been included.

Intelligent Computing Methodologies - De-Shuang Huang 2018-08-08

This book constitutes - in conjunction with the two-volume set LNCS 10954 and LNCS 10955 - the refereed proceedings of the 14th International Conference on Intelligent Computing, ICIC 2018, held in Wuhan, China, in August 2018. The 275 full papers and 72 short papers of the three proceedings volumes were carefully reviewed and selected from 632 submissions. The papers are organized in topical sections such as Evolutionary Computation and Learning; Neural Networks; Pattern Recognition; Image Processing; Information Security; Virtual Reality and Human-Computer Interaction; Business Intelligence and Multimedia Technology; Biomedical Informatics Theory and Methods; Swarm Intelligence and Optimization; Natural Computing; Quantum Computing; Intelligent Computing in Computer Vision; Fuzzy Theory and Algorithms; Machine Learning; Systems Biology; Intelligent Systems and Applications for Bioengineering; Evolutionary Optimization: Foundations and Its Applications to Intelligent Data Analytics; Swarm Evolutionary Algorithms for Scheduling and Combinatorial Optimization; Swarm

Intelligence and Applications in Combinatorial Qoptimization; Advances in Metaheuristic Optimization Algorithm; Advances in Image Processing and Pattern Techniques; Bioinformatics.

Glimpses Of Kashmir - S.K. Sopory 2004

The Book Contains The Proceedings Of A Seminar Relating To Kashmir And Attempts To Bring About A Synthesis Of Various Scientific Discipline As Well As Synthesis Of Science And Culture And Spritual Heritage Of Kashmir. Divided Into Ii Parts, Part I Covers Contribution Of Kashmiri Scientists And Part Ii Relates To Science, Spirituality And Kashmir Shaivism.

Singular-Perturbation Theory - Donald R. Smith 1985-08-30

Introduction to singular perturbation problems. Since the nature of the nonuniformity can vary from case to case, the author considers and solves a variety of problems, mostly for ordinary differential equations.

Recent Advances in Computational and Applied Mathematics - Theodore E. Simos 2010-10-10

This multi-author contributed proceedings volume contains recent advances in several areas of Computational and Applied Mathematics. Each review is written by well known leaders of Computational and Applied Mathematics. The book gives a comprehensive account of a variety of topics including – Efficient Global Methods for the Numerical Solution of Nonlinear Systems of Two point Boundary Value Problems; Advances on collocation based numerical methods for Ordinary Differential Equations and Volterra Integral Equations; Basic Methods for Computing Special Functions, Melt Spinning: Optimal Control and Stability Issues; Brief survey on the CP methods for the Schrödinger equation; Symplectic Partitioned Runge-Kutta methods for the numerical integration of periodic and oscillatory problems. Recent Advances in Computational and Applied Mathematics is aimed at advanced undergraduates and

researchers who are working in these fast moving fields.

Applied Mathematical Analysis: Theory, Methods, and Applications - Hemen Dutta 2019-02-21

This book addresses key aspects of recent developments in applied mathematical analysis and its use. It also highlights a broad range of applications from science, engineering, technology and social perspectives. Each chapter investigates selected research problems and presents a balanced mix of theory, methods and applications for the chosen topics. Special emphasis is placed on presenting basic developments in applied mathematical analysis, and on highlighting the latest advances in this research area. The book is presented in a self-contained manner as far as possible, and includes sufficient references to allow the interested reader to pursue further research in this still-developing field. The primary audience for this book includes graduate students, researchers and educators; however, it will also be useful for general readers with an interest in recent developments in applied mathematical analysis and applications.

The Boundary Function Method for Singular Perturbed Problems - Adelaida B. Vasil'eva 1995-01-01

This book is devoted solely to the boundary function method, which is one of the asymptotic methods.

Computational Methods for a Class of Singular Perturbation Problems - Kolloju Phaneendra 2012

Singular perturbation problems arise in various fields of engineering and science such as fluid dynamics, elasticity, quantum mechanics, electrical networks, chemical reactor-theory, bio-chemical kinetics, gas porous electrodes theory, aerodynamics, plasma dynamics, oceanography, diffraction theory, reaction-diffusion process and many other areas. If we apply the existing standard numerical methods for solving these problems, large oscillations

may arise and pollute the solutions in the entire interval because of the boundary layer behavior. Thus more efficient and simpler computational techniques are required to solve singularly perturbed two-point boundary value problems. In this book, we have proposed and illustrated some simple and efficient computational methods for solving singularly perturbed two-point boundary value problems, singularly perturbed delay differential equations and singularly perturbed singular boundary value problems.

Fitted Numerical Methods for Singular Perturbation Problems - John J. H. Miller 2012

Since the first edition of this book, the literature on fitted mesh methods for singularly perturbed problems has expanded significantly. Over the intervening years, fitted meshes have been shown to be effective for an extensive set of singularly perturbed partial differential equations. In the revised version of this book, the reader will find an introduction to the basic theory associated with fitted numerical methods for singularly perturbed differential equations. Fitted mesh methods focus on the appropriate distribution of the mesh points for singularly perturbed problems. The global errors in the numerical approximations are measured in the pointwise maximum norm. The fitted mesh algorithm is particularly simple to implement in practice, but the theory of why these numerical methods work is far from simple. This book can be used as an introductory text to the theory underpinning fitted mesh methods.

Methods and Applications of Singular Perturbations - Ferdinand Verhulst 2006-06-04

Contains well-chosen examples and exercises A student-friendly introduction that follows a workbook type approach

Layer Resolving Grids and Transformations for Singular Perturbation Problems - Vladimir D. Liseikin 2018-11-05

The approach of layer-damping

coordinate transformations to treat singularly perturbed equations is a relatively new, and fast growing area in the field of applied mathematics. This monograph aims to present a clear, concise, and easily understandable description of the qualitative properties of solutions to singularly perturbed problems as well as of the essential elements, methods and codes of the technology adjusted to numerical solutions of equations with singularities by applying layer-damping coordinate transformations and corresponding layer-resolving grids. The first part of the book deals with an analytical study of estimates of the solutions and their derivatives in layers of singularities as well as suitable techniques for obtaining results. In the second part, a technique for building the coordinate transformations eliminating boundary and interior layers, is presented. Numerical algorithms based on the technique which is developed for generating layer-damping coordinate transformations and their corresponding layer-resolving meshes are presented in the final part of this volume. This book will be of value and interest to researchers in computational and applied mathematics.

Singular Perturbations and Boundary Layers - Gung-Min Gie 2018-11-21

Singular perturbations occur when a small coefficient affects the highest order derivatives in a system of partial differential equations. From the physical point of view singular perturbations generate in the system under consideration thin layers located often but not always at the boundary of the domains that are called boundary layers or internal layers if the layer is located inside the domain. Important physical phenomena occur in boundary layers. The most common boundary layers appear in fluid mechanics, e.g., the flow of air around an airfoil or a whole airplane, or the flow of air around a car. Also in many instances in geophysical fluid mechanics, like the

interface of air and earth, or air and ocean. This self-contained monograph is devoted to the study of certain classes of singular perturbation problems mostly related to thermic, fluid mechanics and optics and where mostly elliptic or parabolic equations in a bounded domain are considered. This book is a fairly unique resource regarding the rigorous mathematical treatment of boundary layer problems. The explicit methodology developed in this book extends in many different directions the concept of correctors initially introduced by J. L. Lions, and in particular the lower- and higher-order error estimates of asymptotic expansions are obtained in the setting of functional analysis. The review of differential geometry and treatment of boundary layers in a curved domain is an additional strength of this book. In the context of fluid mechanics, the outstanding open problem of the vanishing viscosity limit of the Navier-Stokes equations is investigated in this book and solved for a number of particular, but physically relevant cases. This book will serve as a unique resource for those studying singular perturbations and boundary layer problems at the advanced graduate level in mathematics or applied mathematics and may be useful for practitioners in other related fields in science and engineering such as aerodynamics, fluid mechanics, geophysical fluid mechanics, acoustics and optics.

Layer-Adapted Meshes for Reaction-Convection-Diffusion Problems - Torsten Linß 2009-12-17

This is a book on numerical methods for singular perturbation problems – in part- ular, stationary reaction-convection-diffusion problems exhibiting layer behaviour. More precisely, it is devoted to the construction and analysis of layer-adapted meshes underlying these numerical methods. Numerical methods for singularly perturbed differential equations have been studied since the early

1970s and the research frontier has been constantly - panding since. A comprehensive exposition of the state of the art in the analysis of numerical methods for singular perturbation problems is [141] which was p- lished in 2008. As that monograph covers a big variety of numerical methods, it only contains a rather short introduction to layer-adapted meshes, while the present book is exclusively dedicated to that subject. An early important contribution towards the optimisation of numerical methods by means of special meshes was made by N.S. Bakhvalov [18] in 1969. His paper spawned a lively discussion in the literature with a number of further meshes - ing proposed and applied to various singular perturbation problems. However, in the mid 1980s, this development stalled, but was enlivened again by G.I. Shishkin's proposal of piecewise-equidistant meshes in the early 1990s [121,150]. Because of their very simple structure, they are often much easier to analyse than other meshes, although they give numerical approximations that are inferior to solutions on c- peting meshes. Shishkin meshes for numerous problems and numerical methods have been studied since and they are still very much in vogue.

Singularly Perturbed Boundary-Value Problems - Luminita Barbu 2007-12-14

This book offers a detailed asymptotic analysis of some important classes of singularly perturbed boundary value problems which are mathematical models for phenomena in biology, chemistry, and engineering. The authors are particularly interested in nonlinear problems, which have gone little-examined so far in literature dedicated to singular perturbations. The treatment presented here combines successful results from functional analysis, singular perturbation theory, partial differential equations, and evolution equations.

Parameter Uniform Numerical Methods for Singular

Perturbation Problems - Jugal Mohapatra 2012-04
Singularly perturbed boundary-value problems(SPP) arise in several branches of engineering and applied mathematics where the edge effects are important. These problems are often described by differential equations where the highest order derivative is multiplied by an arbitrarily small parameter` `known as the singular perturbation parameter. The solution of these problems possesses boundary (or interior) layers which are thin narrow regions in the neighborhood of the boundary (or interior) of the domain, where the gradient of the solution becomes very high as goes to zero. Classical numerical schemes fails to yield satisfactory numerical approximations on uniform grids due to the presence of boundary layers. To solve SPP, fitted mesh methods are often followed which comprise of standard finite difference operators on specially designed meshes. The aim of this book revolves around developing, analyzing and optimizing the - uniform upwind based fitted mesh methods resolving the convection-dominated layer type problems using non uniform grids.
Fitted Numerical Methods for Singular Perturbation Problems - J. J. H. Miller 2012
Since the first edition of this book, the literature on fitted mesh methods for singularly perturbed problems has expanded significantly. Over the intervening years, fitted meshes have been shown to be effective for an extensive set of singularly perturbed partial differential equations. In the revised version of this book, the reader will find an introduction to the basic theory associated with fitted numerical methods for singularly perturbed differential equations. Fitted mesh methods focus on the appropriate distribution of the mesh points for singularly perturbed problems. The global errors in the numerical approximations are measured in the pointwise maximum norm. The fitted mesh

algorithm is particularly simple to implement in practice, but the theory of why these numerical methods work is far from simple. This book can be used as an introductory text to the theory underpinning fitted mesh methods.

Robust Numerical Methods for Singularly Perturbed Differential Equations - Hans-Görg Roos 2008-09-17

This new edition incorporates new developments in numerical methods for singularly perturbed differential equations, focusing on linear convection-diffusion equations and on nonlinear flow problems that appear in computational fluid dynamics.

hp-Finite Element Methods for Singular Perturbations - Jens M. Melenk 2004-10-20

Many partial differential equations arising in practice are parameter-dependent problems that are of singularly perturbed type. Prominent examples include plate and shell models for small thickness in solid mechanics, convection-diffusion problems in fluid mechanics, and equations arising in semi-conductor device modelling. Common features of these problems are layers and, in the case of non-smooth geometries, corner singularities. Mesh design principles for the efficient approximation of both features by the hp-version of the finite element method (hp-FEM) are proposed in this volume. For a class of singularly perturbed problems on polygonal domains, robust exponential convergence of the hp-FEM based on these mesh design principles is established rigorously.

Singular Perturbation Methods for Ordinary Differential Equations - Robert E., Jr. O'Malley 2012-12-06

This book results from various lectures given in recent years. Early drafts were used for several single semester courses on singular perturbation meth ods given at Rensselaer, and a more complete version was used for a one year course at the Technische Universitat Wien. Some portions have been used for short lecture series at Universidad Central de

Venezuela, West Vir ginia University, the University of Southern California, the University of California at Davis, East China Normal University, the University of Texas at Arlington, Universita di Padova, and the University of New Hampshire, among other places. As a result, I've obtained lots of valuable feedback from students and listeners, for which I am grateful. This writing continues a pattern. Earlier lectures at Bell Laboratories, at the University of Edin burgh and New York University, and at the Australian National University led to my earlier works (1968, 1974, and 1978). All seem to have been useful for the study of singular perturbations, and I hope the same will be true of this monograph. I've personally learned much from reading and analyzing the works of others, so I would especially encourage readers to treat this book as an introduction to a diverse and exciting literature. The topic coverage selected is personal and reflects my current opin ions. An attempt has been made to encourage a consistent method of ap proaching problems, largely through correcting outer limits in regions of rapid change. Formal proofs of correctness are not emphasized.

Information Computing and Applications - Baoxiang Liu 2011-12-08

This book constitutes the refereed proceedings of the Second International Conference on Information Computing and Applications, ICICA 2010, held in Qinhuangdao, China, in October 2011. The 97 papers presented were carefully reviewed and selected from numerous submissions. They are organized in topical sections on computational economics and finance, computational statistics, mobile computing and applications, social networking and computing, intelligent computing and applications, internet and Web computing, paralelle and distributed computing, and system simulation and computing.

Numerical Methods for Stiff Equations and Singular Perturbation Problems - A. Miranker 2001-11-30
Approach your problems from It isn't that they can't see the the right end and begin with the solution. It is that they can't see the problem. answers. Then, one day, perhaps you will find the final question. The Hermit Clad in Crane Feathers' G. K. Chesterton, The scandal of in R. Van Gulik's The Chinese Maze Father Brown "The point ofa pin" Murders. Growing specialization and diversification have brought a host of monographs and textbooks on increasingly specialized topics. However, the 'tree' of knowledge of mathematics and related fields does not grow only by putting forth new branches. It also happens, quite often in fact, that branches which were thought to be completely disparate are suddenly seen to be related. Further, the kind and level of sophistication of mathematics applied in various sciences has changed drastically in recent years: measure theory is used (non-trivially) in regional and theoretical economics; algebraic geometry interacts with physics; the Minkowsky lemma, coding theory and the structure of water meet one another in packing and covering theory; quantum fields, crystal defects and mathematical programming profit from homotopy theory; Lie algebras are relevant to filtering; and prediction and electrical engineering can use Stein spaces.

Numerical Methods for Singularly Perturbed Differential Equations - Hans-G. Roos 1996-03-14
The analysis of singular perturbed differential equations began early in this century, when approximate solutions were constructed from asymptotic ex pansions. (Preliminary attempts appear in the nineteenth century [vD94].) This technique has flourished since the mid-1960s. Its principal ideas and methods are described in several textbooks. Nevertheless, asymptotic ex pansions may be

impossible to construct or may fail to simplify the given problem; then numerical approximations are often the only option. The systematic study of numerical methods for singular perturbation problems started somewhat later - in the 1970s. While the research frontier has been steadily pushed back, the exposition of new developments in the analysis of numerical methods has been neglected. Perhaps the only example of a textbook that concentrates on this analysis is [DMS80], which collects various results for ordinary differential equations, but many methods and techniques that are relevant today (especially for partial differential equa tions) were developed after 1980.Thus contemporary researchers must comb the literature to acquaint themselves with earlier work. Our purposes in writing this introductory book are twofold. First, we aim to present a structured account of recent ideas in the numerical analysis of singularly perturbed differential equations. Second, this important area has many open problems and we hope that our book will stimulate further investigations.Our choice of topics is inevitably personal and reflects our own main interests.

Soft Computing for Problem Solving - Jagdish Chand Bansal 2018-10-30

This two-volume book presents outcomes of the 7th International Conference on Soft Computing for Problem Solving, SocProS 2017. This conference is a joint technical collaboration between the Soft Computing Research Society, Liverpool Hope University (UK), the Indian Institute of Technology Roorkee, the South Asian University New Delhi and the National Institute of Technology Silchar, and brings together researchers, engineers and practitioners to discuss thought-provoking developments and challenges in order to select potential future directions The book presents the latest advances and innovations in the interdisciplinary areas of soft computing, including original

research papers in the areas including, but not limited to, algorithms (artificial immune systems, artificial neural networks, genetic algorithms, genetic programming, and particle swarm optimization) and applications (control systems, data mining and clustering, finance, weather forecasting, game theory, business and forecasting applications). It is a valuable resource for both young and experienced researchers dealing with complex and intricate real-world problems for which finding a solution by traditional methods is a difficult task.

High Performance Computing - HiPC 2006 - Yves L. Robert 2006-12-18

This book constitutes the refereed proceedings of the 13th International Conference on High-Performance Computing, HiPC 2006, held in Bangalore, India, December 2006. Coverage in this volume includes scheduling and load balancing, network and distributed algorithms, application software, network services, ad-hoc networks, systems software, sensor networks and performance evaluation, as well as routing and data management algorithms.

Contributions to the asymptotic and numerical solution of singular perturbation problems - Hans-Jürgen Reinhardt 1982

Numerical Solution of Stiff and Singularly Perturbed Problems - A. M. Nagy 2013

In recent years much attention has been given to the numerical solution of ODEs. Of particular interest has been the solution of singularly perturbed and stiff problems. These types of problems arise in various fields of science and engineering such as fluid mechanics, physics, chemistry, mechanics, chemical reactor theory, convection diffusion processes, optimal control and other branches of applied mathematics. Singular perturbation problems depend on the presence of a small, positive parameter which provides a multi-scale character to the solution. That

is the solution varies very rapidly in some parts of the region of integration (layers) and varies slowly in other parts. Stiffness is a property of the differential problem that makes slow and expensive the computation of the numerical solution using classical explicit methods. In this work, we present some numerical methods for solving IVPs and BVBs. Moreover, we give numerical solutions of Volterra integral and integro-differential equations. This book is high recommended to both postgraduate students and researchers in a wide variety of applications.

Introduction to Singular Perturbations - Robert E. Jr. O'Malley 2012-12-02

Introduction to Singular Perturbations provides an overview of the fundamental techniques for obtaining asymptomatic solutions to boundary value problems. This text explores singular perturbation techniques, which are among the basic tools of several applied scientists. This book is organized into eight chapters, wherein Chapter 1 discusses the method of matched asymptomatic expansions, which has been frequently applied to several physical problems involving singular perturbations. Chapter 2 considers the nonlinear initial value problem to illustrate the regular perturbation method, and Chapter 3 explains how to construct asymptotic solutions for general linear equations. Chapter 4 discusses scalar equations and nonlinear system, whereas Chapters 5 and 6 explain the contrasts for initial value problems where the outer expansion cannot be determined without obtaining the initial values of the boundary layer correction. Chapters 7 and 8 deal with boundary value problem that arises in the study of adiabatic tubular chemical flow reactors with axial diffusion. This monograph is a valuable resource for applied mathematicians, engineers, researchers, students, and readers whose interests span a variety of fields.

Handbook of Splines -

Gheorghe Micula 2012-12-06 The purpose of this book is to give a comprehensive introduction to the theory of spline functions, together with some applications to various fields, emphasizing the significance of the relationship between the general theory and its applications. At the same time, the goal of the book is also to provide new ma terial on spline function theory, as well as a fresh look at old results, being written for people interested in research, as well as for those who are interested in applications. The theory of spline functions and their applications is a relatively recent field of applied mathematics. In the last 50 years, spline function theory has undergone a won derful development with many new directions appearing during this time. This book has its origins in the wish to adequately describe this development from the notion of 'spline' introduced by 1. J. Schoenberg (1901-1990) in 1946, to the newest recent theories of 'spline wavelets' or 'spline fractals'. Isolated facts about the functions now called 'splines' can be found in the papers of L. Euler, A. Lebesgue, G. Birkhoff, J.

Advanced Numerical Methods for Differential Equations - Harendra Singh 2021-07-29

Mathematical models are used to convert real-life problems using mathematical concepts and language. These models are governed by differential equations whose solutions make it easy to understand real-life problems and can be applied to engineering and science disciplines. This book presents numerical methods for solving various mathematical models. This book offers real-life applications, includes research problems on numerical treatment, and shows how to develop the numerical methods for solving problems. The book also covers theory and applications in engineering and science. Engineers, mathematicians, scientists, and researchers working on real-life mathematical problems will

find this book useful.

Numerical Methods for Singularly Perturbed Differential Equations - Hans-Görg Roos 2013-06-29

The analysis of singular perturbed differential equations began early in this century, when approximate solutions were constructed from asymptotic ex pansions. (Preliminary attempts appear in the nineteenth century [vD94].) This technique has flourished since the mid-1960s. Its principal ideas and methods are described in several textbooks. Nevertheless, asymptotic ex pansions may be impossible to construct or may fail to simplify the given problem; then numerical approximations are often the only option. The systematic study of numerical methods for singular perturbation problems started somewhat later - in the 1970s. While the research frontier has been steadily pushed back, the exposition of new developments in the analysis of numerical methods has been neglected. Perhaps the only example of a textbook that concentrates on this analysis is [DMS80], which collects various results for ordinary differential equations, but many methods and techniques that are relevant today (especially for partial differential equa tions) were developed after 1980.Thus contemporary researchers must comb the literature to acquaint themselves with earlier work. Our purposes in writing this introductory book are twofold. First, we aim to present a structured account of recent ideas in the numerical analysis of singularly perturbed differential equations. Second, this important area has many open problems and we hope that our book will stimulate further investigations.Our choice of topics is inevitably personal and reflects our own main interests.

Convection-Diffusion Problems: An Introduction to Their Analysis and Numerical Solution - Martin Stynes 2018-11-21

Many physical problems involve diffusive and convective (transport) processes. When

diffusion dominates convection, standard numerical methods work satisfactorily. But when convection dominates diffusion, the standard methods become unstable, and special techniques are needed to compute accurate numerical approximations of the unknown solution. This convection-dominated regime is the focus of the book. After discussing at length the nature of solutions to convection-dominated convection-diffusion problems, the authors motivate and design numerical methods that are particularly suited to this class of problems. At first they examine finite-difference methods for two-point boundary value problems, as their analysis requires little theoretical background. Upwinding, artificial diffusion, uniformly convergent methods, and Shishkin meshes are some of the topics presented. Throughout, the authors are concerned with the accuracy of solutions when the diffusion coefficient is close to zero. Later in the book they concentrate on finite element methods for problems posed in one and two dimensions. This lucid yet thorough account of convection-dominated convection-diffusion problems and how to solve them numerically is meant for beginning graduate students, and it includes a large number of exercises. An up-to-date bibliography provides the reader with further reading.