Multiple Scale And Singular Perturbation Methods

Singular Perturbation Methods in ControlSingular Perturbation Methods for Ordinary Differential EquationsIntroduction to Singular PerturbationsSingular Perturbation Methods in ControlSingular Perturbation Methodology in Control SystemsSingular Perturbation Methods in controlPerturbationsMultiple Scale and Singular Perturbation MethodsSingular Perturbation TheoryMultiple Scale and Singular Perturbation MethodsAnalyzing Multiscale Phenomena Using Singular Perturbation MethodsAlgebraic Analysis of Singular Perturbation TheorySingular Perturbation Methods in ControlThe Boundary Function Method for Singular Perturbed ProblemsDifference Methods for Singular Perturbation ProblemsAnalyzing Multiscale Phenomena Using Singular Perturbation MethodsThe Theory of Singular PerturbationsFitted Numerical Methods For Singular Perturbation Problems: Error Estimates In The Maximum Norm For Linear Problems In One And Two Dimensions (Revised Edition)Singular Perturbations and HysteresisMethods and Applications of Singular Perturbations Petar Kokotovic Robert E., Jr. O'Malley Robert E. Jr. O'Malley Petar V. Kokotovic Desineni S. Naidu Petar V. Kokotović James A. Murdock J.K. Kevorkian R.S. Johnson J K Kevorkian Jane Cronin Takahiro Kawai Petar Kokotovic Adelaida B. Vasil'eva Grigory I. Shishkin Jane Cronin E.M. de Jager John J H Miller Michael P. Mortell Ferdinand Verhulst

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this siam classics edition of the 1986 book provides the theoretical foundation for

representative control applications

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

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

this book presents the twin topics of singular perturbation methods and time scale analysis to problems in systems and control the heart of the book is the singularly perturbed optimal control systems which are notorious for demanding excessive computational costs the book addresses both continuous control systems described by differential equations and discrete control systems characterised by difference equations

perturbations theory and methods gives a thorough introduction to both regular and

singular perturbation methods for algebraic and differential equations unlike most introductory books on the subject this one distinguishes between formal and rigorous asymptotic validity which are commonly confused in books that treat perturbation theory as a bag of heuristic tricks with no foundation the meaning of uniformity is carefully explained in a variety of contexts all standard methods such as rescaling multiple scales averaging matching and the wkb method are covered and the asymptotic validity in the rigorous sense of each method is carefully proved first published in 1991 this book is still useful today because it is an introduction it combines perturbation results with those known through other methods sometimes a geometrical result such as the existence of a periodic solution is rigorously deduced from a perturbation result and at other times a knowledge of the geometry of the solutions is used to aid in the selection of an effective perturbation method dr murdock s approach differs from other introductory texts because he attempts to present perturbation theory as a natural part of a larger whole the mathematical theory of differential equations he explores the meaning of the results and their connections to other ways of studying the same problems

this book is a revised and updated version including a substantial portion of new material of our text perturbation methods in applied mathematics springer verlag 1981 we present the material at a level that assumes some familiarity with the basics of ordinary and partial differential equations some of the more advanced ideas are reviewed as needed therefore this book can serve as a text in either an advanced undergraduate course or a graduate level course on the subject perturbation methods first used by astronomers to predict the effects of small disturbances on the nominal motions of celestial bodies have now become widely used analytical tools in virtually all branches of science a problem lends itself to perturbation analysis if it is close to a simpler problem that can be solved exactly typically this closeness is measured by the occurrence of a small dimensionless parameter e in the governing system consisting of differential equations and boundary conditions so that for e 0 the resulting system is exactly solvable the main mathematical tool used is asymptotic expansion with respect to a suitable asymptotic sequence of functions of e in a regular perturbation problem a straightforward procedure leads to a system of differential equations and boundary conditions for each term in the asymptotic expansion this system can be solved recursively and the accuracy of the result improves as e gets smaller for all values of the independent variables throughout the domain of interest we discuss regular perturbation problems in the first chapter

the importance of mathematics in the study of problems arising from the real world and the increasing success with which it has been used to model situations ranging from the purely deterministic to the stochastic is well established the purpose of the set of volumes to which the present one belongs is to make available authoritative up to date and self contained accounts of some of the most important and useful of these analytical approaches and techniques each volume provides a detailed introduction to a specific subject area of current importance that is summarized below and then goes beyond this by reviewing recent contributions and so serving as a valuable reference source the progress

in applicable mathematics has been brought about by the extension and development of many important analytical approaches and techniques in areas both old and new frequently aided by the use of computers without which the solution of realistic problems would otherwise have been impossible

this book is a revised and updated version including a substantial portion of new material of the authors widely acclaimed earlier text perturbation methods in applied mathematics a new chapter dealing with regular expansions has been added the discussion of layer type singular perturbations has been revised and the coverage of multiple scale and averaging methods has been significantly expanded to reflect recent advances and viewpoints the result is a comprehensive account of the various perturbation techniques currently used in the sciences and engineering and is suitable for a graduate text as well as a reference work on the subject

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 topic of this book is the study of singular perturbations of ordinary differential equations i e perturbations that represent solutions as asymptotic series rather than as analytic functions in a perturbation parameter the main method used is the so called wkb wentzel kramers brillouin method originally invented for the study of quantum mechanical systems the authors describe in detail the wkb method and its applications to the study of monodromy problems for fuchsian differential equations and to the analysis of painleve functions this volume is suitable for graduate students and researchers interested in differential equations and special functions

singular perturbations and time scale techniques were introduced to control engineering in the late 1960s and have since become common tools for the modeling analysis and design of control systems in this siam classics edition of the 1986 book the original text is reprinted in its entirety along with a new preface providing once again the theoretical foundation for representative control applications this book continues to be essential in many ways it lays down the foundation of singular perturbation theory for linear and nonlinear systems it presents the methodology in a pedagogical way that is not available anywhere else and it illustrates the theory with many solved examples including various physical examples and applications so while new developments may go beyond the topics covered in this book they are still based on the methodology described here which

continues to be their common starting point

this book is devoted solely to the boundary function method which is one of the asymptotic methods

difference methods for singular perturbation problems focuses on the development of robust difference schemes for wide classes of boundary value problems it justifies the ⍰ uniform convergence of these schemes and surveys the latest approaches important for further progress in numerical methods the first part of the book e

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 subject of this textbook is the mathematical theory of singular perturbations which despite its respectable history is still in a state of vigorous development singular perturbations of cumulative and of boundary layer type are presented attention has been given to composite expansions of solutions of initial and boundary value problems for ordinary and partial differential equations linear as well as quasilinear also turning points are discussed the main emphasis lies on several methods of approximation for solutions of singularly perturbed differential equations and on the mathematical justification of these methods the latter implies a priori estimates of solutions of differential equations this involves the application of gronwall s lemma maximum principles energy integrals fixed point theorems and gåding s theorem for general elliptic equations these features make the book of value to mathematicians and researchers in the engineering sciences interested in the mathematical justification of formal approximations of solutions of practical perturbation problems the text is selfcontained and each chapter is concluded with some exercises

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

this book unifies many important recent developments in the analysis of singular perturbation and hysteresis phenomena in an accessible and comprehensive fashion in april 2002 at university college cork in ireland the editors conducted a workshop to provide a forum for experts to share their interests and knowledge for this book the editors have compiled research from those practitioners in areas such as reacting systems semiconductor lasers shock phenomena in economic modeling and fluid mechanics all with an emphasis on hysteresis and singular perturbations a basic introduction to hysteresis and singular perturbation theory is included with simple examples from both physics and mathematics later chapters address applications of hysteresis to economics various aspects of the asymptotic theory of singularly perturbed systems typical problems of the asymptotic theory of contrast structures and the geometrical approach to an investigation of models with singular perturbations and hysteresis

contains well chosen examples and exercises a student friendly introduction that follows a workbook type approach

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