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Chapter 1 : Perturbation Methods for Engineers and Scientists - Alan W. Bush - Google Books

Perturbation Methods for Engineers and Scientists examines the main techniques of perturbation expansions applied to both differential equations and integral expressions. It describes several fluid dynamics applications, including aerofoils, boundary layers in momentum heat, and mass transfer.

About this product Synopsis A clear, practical and self-contained presentation of the methods of asymptotics and perturbation theory for obtaining approximate analytical solutions to differential and difference equations. Aimed at teaching the most useful insights in approaching new problems, the text avoids special methods and tricks that only work for particular problems. Intended for graduates and advanced undergraduates, it assumes only a limited familiarity with differential equations and complex variables. The presentation begins with a review of differential and difference equations, then develops local asymptotic methods for such equations, and explains perturbation and summation theory before concluding with an exposition of global asymptotic methods. Emphasizing applications, the discussion stresses care rather than rigor and relies on many well-chosen examples to teach readers how an applied mathematician tackles problems. There are computer-generated plots and tables comparing approximate and exact solutions, over problems of varying levels of difficulty, and an appendix summarizing the properties of special functions. Our objective is to help young and also establiShed scientists and engineers to build the skills necessary to analyze equations that they encounter in their work. Our presentation is aimed at developing the insights and techniques that are most useful for attacking new problems. We do not emphasize special methods and tricks which work only for the classical transcendental functions; we do not dwell on equations whose exact solutions are known. The mathematical methods discussed in this book are known collectively as asymptotic and perturbative analysis. These are the most useful and powerful methods for finding approximate solutions to equations, but they are difficult to justify rigorously. Thus, we concentrate on the most fruitful aspect of applied analysis; namely, obtaining the answer. We stress care but not rigor. To explain our approach, we compare our goals with those of a freshman calculus course. A beginning calculus course is considered successful if the students have learned how to solve problems using calculus. These methods allow one to analyze physics and engineering problems that may not be solvable in closed form and for which brute-force numerical methods may not converge to useful solutions. The objective of this book is to teaching the insights and problem-solving skills that are most useful in solving mathematical problems arising in the course of modern research. Intended for graduate students and advanced undergraduates, the book assumes only a limited familiarity with differential equations and complex variables. The presentation begins with a review of differential and difference equations; develops local asymptotic methods for differential and difference equations; explains perturbation and summation theory; and concludes with a an exposition of global asymptotic methods, including boundary-layer theory, WKB theory, and multiple-scale analysis. Emphasizing applications, the discussion stresses care rather than rigor and relies on many well-chosen examples to teach the reader how an applied mathematician tackles problems. There are computer-generated plots and tables comparing approximate and exact solutions; over problems, of varying levels of difficulty; and an appendix summarizing the properties of special functions.

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Chapter 2 : Course Overview : The American Institute of Aeronautics and Astronautics

The subject of perturbation expansions is a powerful analytical technique which can be applied to problems which are too complex to have an exact solution, for example, calculating the drag of an aircraft in flight.

JSTOR is a not-for-profit service that helps scholars, researchers, and students discover, use, and build upon a wide range of content in a trusted digital archive. We use information technology and tools to increase productivity and facilitate new forms of scholarship. For the user, how- ever, in addition to the main subroutine pltmg essentially only six others are of interest and, of course, the driving program. Very informative descriptions of these are given in Chapters , followed by a short chapter on the only machine-dependent subprograms-dealing with timing and the graphics interface. Although a reader may be overwhelmed at first by the wealth of possibilities to control and display the solution process, a careful study of each section will show that with the explanations given all the capabili- ties provided can be exploited with ease. While, for example, the casual reader of Chapter 2 may think that the initial triangulation would always have to be defined rather explicitly, in Chapter 3 it becomes clear that only a comparably coarse def- inition of the domain skeleton is needed for the built-in triangulation procedure. Subsequently, triangulations can be refined adaptively using a posteriori error estimators to a level limited only by the available memory, but they can also be un- refined and also a new skeleton may be formed and the domain retriangulated in order to have, for example, the grid lines aligned with contours of the solution. To given an indication of the variety of output possibilities we just mention that fifteen different tables and curves may be displayed at any time and more than twenty functions. Here, naturally one of the output formats is PostScript. This book is indispensable for any user of PLTMG but also for everyone who wants to see a prime example of a modem scientific computing package incorporating ideas from both computer science data structures, graphics, etc. By Alan W Bush. This is an introduction to perturbation methods, at the beginning graduate level, suitable for courses focusing on methods rather than justification. The author introduces perturbation expansions with a few examples, such as motion with small friction, roots of polynomials, and integration by parts. This leads to a second chapter on order symbols, asymptotic expansions, and uniformity. The next four chapters are each devoted to one of the basic classes of perturbation methods for dif- ferential equations, strained coordinates, multi- ple scales, matching, and WKB. Strained coordi- nates are handled mostly by renormalization, that is, computing a nonuniform straightforward ex- pansion and then rendering it uniform by strain- ing. A final chapter concerns asymptotic evalu- ation of integrals. The chapters on strained coor- dinates, multiple scales, and matching each have lengthy sections treating a serious physical appli- cation at a depth that is unusual in an introduc- tory book; for strained coordinates and matching, these concern fluid flow, while for multiple scales the application is to lubricated bearings. From the standpoint of nonlinear oscillations, the offerings here are meager. The Lindstedt method for periodic solutions is given, and the multiple scale method is applied to the unforced Van der Pol oscillator. The method of averag- ing is touched on in three pages, treating only the leading order approximation for the general, un- forced, nearly linear oscillator in one degree of freedom. In fact the use of this formula "assumes" nothing; it is merely a change of variables from u, u to a, 0. Much of the theoretical advantage of the method of av- eraging results from the fact that it, as opposed to the method of multiple scales, does not begin by postulating a form for the solution arbitrarily. This enables every step to be justified in a natu- ral way, with rigorous conclusions both as to the existence and stability of periodic solutions, and as to error estimates for the approximations for both periodic and transient solutions. Multiple scales can sometimes be justified also, but only after the approximate solution is computed; it is the solution itself that is justified, not the steps on the way to the solution. No one would guess any of this from the presentation given here. This content downloaded from Begin- ning with a simple linear example, the author computes the outer solution and the exact solu- tion, and by comparing them, discovers the ex- istence of a boundary layer. Next, some examples having different behavior are given: A short section on nonlinear examples follows. Finally, there is a long almost 40 pages section dealing with the Navier-Stokes equation, Reynolds and Prandtl numbers, the Blasius solution, thermal boundary layers, and so forth, containing several computer programs and tables of output. Much of this material is unknown to me, but it looks quite readable and if I wanted to learn it I would certainly begin here. For the sake of illustration, I have made this mistake myself when I said above that renormalizing takes a nonuniform expansion and renders it uniform. In fact, renormalization only takes a "disordered" expansion and renders it "uniformly ordered. This practice is partly responsible for the undeserved reputation that perturbation theory sometimes has among mathematicians, a reputation roughly comparable to that of tabloid newspapers. I do not ask that a book at this level provide proofs of actual uniformity. But it is not unreasonable to ask two things: These things could be done in the book under review with the addition of only a few pages in Chapter 2 and the changing of a few words else- where. This much honesty would not, of course, change the reputation of the field overnight, but it might gradually elevate the level of awareness with which perturbation theory is used. I would urge those adopting this textbook to make these points clear to their students. Longman, Essex, England, A transformation T satisfying 2 is called a one parameter semigroup of transformations on Q or simply a semigroup. In the former case T is called continuous. Generally, if T arises from ordinary differential equations, T is continuous whereas if T arises from partial differential equations, then T is at most strongly continuous. The book under review concerns mainly strongly continuous semigroups of linear trans- formations, although applications to nonlinear problems are a major concern. For linear strongly continuous semigroups on a Banach space X This content downloaded from Problems and Solutions [pp.

Chapter 3 : perturbation methods | Download eBook PDF/EPUB

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Initializing Snakes by W. In this paper, we propose a snake-based approach that lets a user specify only the distant end points of the curve he wishes to delineate without having to supply an almost complete polygonal approximation. We achieve much better convergence properties than those of traditional snakes by using the i We achieve much better convergence properties than those of traditional snakes by using the image information around these end points to provide boundary conditions and by introducing an optimization schedule that allows the snake to take image information into account first only near its extremities and then, progressively, towards its center. Ziplock Snakes by W. We propose a snake-based approach that allows a user to specify only the distant end points of the curve he wishes to delineate without having to supply an almost complete polygonal approximation. This greatly simplifies the initialization process and yields excellent convergence properties. This is achieved by using the image information around the end points to provide boundary conditions and by introducing an optimization schedule that allows a snake to take image information into account first only near its extremities and then, progressively, toward its center. In effect, the snakes are clamped onto the image contour in a manner reminiscent of a ziplock being closed. These snakes can be used to alleviate the often repetitive task practitioners face when segmenting images by eliminating the need to sketch a feature of interest in its entirety, that is, to perform a painstaking, almost complete, manual segmentation. Snakes, Deformable models, Interactive initialization, B Steady states and dynamics of 2-D nematic polymers driven by an imposed weak shear by Hong Zhou, Hongyun Wang - Communications in Mathematical Sciences , " We study the 2-D Smoluchowski equation governing the evolution of orientational distribution of rodlike molecules under an imposed weak shear. We first recover the well-known isotropic-to-nematic phase transition result [G. Maffettone, Description of the liquid-crystalli Maffettone, Description of the liquid-crystalline phase of rodlike polymers at high shear rates, Macromolecules, 22, ,]: Furthermore, we carry out multi-scale asymptotic anlaysis to study the slow time evolution driven by the weak shear. It is revealed that, to the leading order, the order parameter of the orientational distribution is invariant with respect to time whereas the angular velocity of the director is position-dependent. Finally, the effect of weak shear on the phase diagram is investigated. It is found that the phase relation under weak shear can be obtained from the pure nematic phase relation through a simple algebraic transformation. Show Context Citation Context The approach of multi-scale expansions has been applied to study the nonlinear dynamics of a nematic liquid crystal under a shear flow for a Landau-de Gennes model Fully developed forced convection through a porous medium bounded by two isoflux parallel plates is investigated analytically on the basis of a Brinkman-Forchheimer model. The matched asymptotic expansion method is applied for small values of the Darcy number. For the case of large Darcy number the For the case of large Darcy number the solution for the Brinkman-Forchheimer momentum equation is found in terms of an asymptotic expansion. With the velocity distribution determined, the energy equation is solved using the same asymptotic technique. The results for limiting cases are found to be in good agreement with those available in the literature and the numerical results obtained here. We study the maximum temperature rise induced by a rotating or dithering Gaussian laser beam on a semi-infinite body. An analytical solution is obtained by solving the transient three-dimensional heat equation in a semi-infinite domain with insulating surface. The effect of rotating or dithering fre The effect of rotating or dithering frequency on maximum temperature rise is quantitatively investigated for stainless steel and carbon nanotube-alumina composites. It is found that the maximum temperature rise can be reduced by increasing the frequency of the rotating or dithering beam and by increasing the radius of the rotating or dithering trajectory. For a fixed frequency, the maximum temperature rise induced by a rotating beam is lower than the one induced by a dithering beam. Finally, we give the asymptotic solution of the temperature rise for

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large frequency of a rotating Gaussian beam. Such regions are called regions of stationary phase. We now turn to the evaluation of Ik.

Chapter 4 : Perturbation Methods for Engineers and Scientists - ePub - AlanW. Bush - Achat ebook | fnac

Provides an account of the main techniques of perturbation expansions applied to both differential equations and integral expressions. The book is intended for students in engineering, applied and.

Chapter 5 : Perturbation Methods for Engineers and www.nxgvision.com Alan W. Bush - [PDF Document]

Perturbation Methods in Science and Engineering Synopsis: "Perturbation Methods in Science and Engineering" is a must for all engineers and scientists aspiring to develop theoretical solutions to accompany their numerical and/or experimental work, irrespective of their research discipline.

Chapter 6 : CiteSeerX â€” Citation Query Perturbation methods for engineers and scientists

1 A perturbation solution for forced convection in a porous saturated duct by K. Hooman Fully developed forced convection through a porous medium bounded by two isoflux parallel plates is investigated analytically on the basis of a Brinkman-Forchheimer model.

Chapter 7 : Perturbation Methods for Engineers and Scientists - CRC Press Book

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