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BEYOND PERTUBATION

Introduction to the Homotopy Analysis Method

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A GENERAL, UNIFIED THEORY HOLDS EVEN FOR HIGHLY NONLINEAR PROBLEMS

Solving nonlinear problems is inherently difficult, and the stronger the nonlinearity, the more intractable solutions become. Analytic approximations often break down as nonlinearity becomes strong, and even perturbation approximations are valid only for problems with weak nonlinearity.

This book introduces a powerful new analytic method for nonlinear problems—homotopy analysis—that remains valid even with strong nonlinearity. In Part I, the author starts with a very simple example, then presents the basic ideas, detailed procedures, and the advantages (and limitations) of homotopy analysis. Part II illustrates the application of homotopy analysis to many interesting nonlinear problems. These range from simple bifurcations of a nonlinear boundary-value problem to the Thomas-Fermi atom model, Volterra's population model, Von Kármán swirling viscous flow, and nonlinear progressive waves in deep water.

Although the homotopy analysis method has been verified in a number of prestigious journals, it has yet to be fully detailed in book form. Written by a pioneer in its development, **Beyond Perturbation: Introduction to the Homotopy Analysis Method** is your first opportunity to explore the details of this valuable new approach, add it to your analytic toolbox, and perhaps make contributions to some of the questions that remain open.

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FEATURES

- Presents a systematic description of homotopy analysis—a new method for nonlinear problems
- Describes a convergence theorem for general cases and shows that other techniques, such as the δ -expansion method, Lyapunov's artificial small parameter method, and Adomian's decomposition method, are only special cases of the homotopy analysis method
- Discusses the method's advantages, limitations, and related open questions
- Illustrates the use of homotopy analysis in many interesting problems that make the formulations, theories, and applications easy to follow

CONTENTS

PART I BASIC IDEAS

Introduction
Illustrative Description
Systematic Description
Relations to Some Previous Analytic Methods
Advantages, Limitations, and Open Questions

PART II APPLICATIONS

Simple Bifurcation of a Nonlinear Problem
Multiple Solutions of a Nonlinear Problem
Nonlinear Eigenvalue Problem
Thomas-Fermi Atom Model
Volterra's Population Model
Free Oscillation Systems with Odd Nonlinearity
Free Oscillation Systems with Quadratic Nonlinearity
Limit Cycle in a Multidimensional System
Blasius' viscous Flow
Boundary-layer Flow with Exponential Property
Boundary-layer Flow with Algebraic Property
Von Kármán Swirling Flow
Nonlinear Progressive Waves in Deep Water
BIBLIOGRAPHY
INDEX