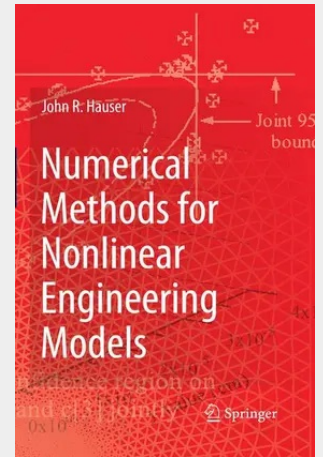


Numerical Methods for Nonlinear Engineering Models

There are many books on the use of numerical methods for solving engineering problems and for modeling of engineering artifacts. In addition there are many styles of such presentations ranging from books with a major emphasis on theory to books with an emphasis on applications. The purpose of this book is hopefully to present a somewhat different approach to the use of numerical methods for engineering applications. Engineering models are in general nonlinear models where the response of some appropriate engineering variable depends in a nonlinear manner on the application of some independent parameter. It is certainly true that for many types of engineering models it is sufficient to approximate the real physical world by some linear model. However, when engineering environments are pushed to extreme conditions, nonlinear effects are always encountered. It is also such extreme conditions that are of major importance in determining the reliability or failure limits of engineering systems. Hence it is essential that engineers have a toolbox of modeling techniques that can be used to model nonlinear engineering systems. Such a set of basic numerical methods is the topic of this book. For each subject area treated, nonlinear models are incorporated into the discussion from the very beginning and linear models are simply treated as special cases of more general nonlinear models. This is a basic and fundamental difference in this book from most books on numerical methods.

The purpose of this book is to develop and illustrate various numerical computer based methods that can be used for engineering models and equations. The intended audience is the practicing engineer who needs to model real world engineering models or the upper level engineering undergraduate or first year graduate student interested in developing skills in computer models of engineering problems. The material is presented in a "learning by example" style whereby many examples are used to develop and illustrate concepts as opposed to extensive mathematical treatments. The book presents an integrated approach to engineering models whereby linear models are treated as simple special cases of more general approaches appropriate for nonlinear models. In addition to standard topics in numerical methods, the material covers the estimation of parameters associated with engineering models and the statistical nature of modeling with nonlinear models. Topics covered include coupled systems of nonlinear equations and coupled systems of nonlinear differential equations. For all the topics covered extensive computer code is developed in a modern computer language that is easy to program and understand. The developed code can be readily used to model real world engineering problems. Finally for all topic areas extensive discussion is included of the accuracy that can be achieved with the various numerical methods and methods are developed that can be used to assess the accuracy of the modeling methods. The book assumes only the normal mathematical background of the introductory college level mathematics courses through calculus. In addition the material can be readily understood by anyone familiar with at least one computer programming language.



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