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Khameel B. Mustapha

R for Finite Element Analyses of Size-dependent Microscale Structures

 Springer

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Preface

The subject of this brief book is the elementary analyses of linear elastic size-dependent structures based on the modified couple stress theory. The book focuses on establishing the governing equations of size-dependent structures (restricted to beams and plates), deriving the associated finite element model and implementing the finite element models in the R programming language. The implemented functions are employed to develop a special R package called *microfiniteR*. With the R package, the book provides an interactive platform for finite element analyses of microscale beams (bending, buckling and free vibration) and plates (bending and free vibration). As far as computational tasks are concerned, the R programming language is well known for statistical computations and data analyses, but it is less associated with typical engineering computations (which it is also well equipped for). An aim of this book is to show its usefulness as a complementary tool in this regard, given the fast development of the language in recent years as a useful tool for reproducible research.

Chapter 1 of the book introduces the R programming language, beginning with the resources needed to make use of the language and ending with a list of recommended texts. In subsequent chapters (2, 3 and 4), we begin with a short introduction, move on to the requisite linear elastic model formulated via the variational method and then present the finite element model as well as the implemented R functions for the finite element analysis. In addition, the chapters are embedded with examples to demonstrate the use of the R functions by examining deformation characteristics (in the case of bending analyses) or the eigenvalues (in the case of dynamics and buckling problems). A brief summary and relevant references are provided at the end of each chapter.

Efforts have been made to check for errors. Nevertheless, the author welcomes notifications on errors or suggestions for corrections, which can be directed to KhameelB.Mustapha@nottingham.edu.my.

Semenyih, Malaysia
2019

Khameel B. Mustapha

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I appreciate the visionary efforts of many unsung heroes who maintained the overwhelmingly large R ecosystem. I thank the developers and contributors to the R language and the inspiring teams at RStudio for their selflessness. It would have been close to impossible to make the package developed for this book without the functionality of RStudio and the **devtools** package by Hadley Wickham and the R Core team.

With regards to the mechanics-related technical content, the information contained in this book, though brief and very elementary, arise from the seminal contributions of many excellent studies on the subject of modified couple stress theory and the finite element method. I am indebted to the authors of books and journal articles on the subject matters.

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