

Preface

Finite elements analysis (FEM) is one of the most powerful tools for the numerical simulation of complex industrial problems. Still new formulations and discretization schemes have to be developed that account for the needs of advanced applications in engineering.

The book is intended for students and engineers who want to develop new finite element formulations, especially for nonlinear problems. The derivations of the finite element matrices and vectors needed for an efficient treatment of nonlinear applications within a finite element environment can become extremely complex and error-prone. Due to the power of symbolic computations it is nowadays possible to automatically generate efficient and highly compressed code for linear and nonlinear problems. By this, tedious hand calculations can be avoided leading to more accurate implementations and huge time savings in the development phase, e.g., of new finite elements or material models.

Based on the symbolic system *AceGen* fast and reliable code can be created with a minimum of effort and immediately be tested and verified by using the associated finite element program *AceFEM*. *AceGen* is a package within *Mathematica* and produces source code for different finite element environments. The use of *AceGen* is described within this book for applications in solid mechanics. For that the basic equations of continuum mechanics are summarized and the input for the symbolic systems is added in order to provide a guide to apply *AceGen* for nonlinear problems of three-dimensional solids such as hyperelasticity, finite deformation plasticity, and sensitivity analysis. In addition, element formulations for structural elements like nonlinear truss-, beam-, and shell structures will be developed.

We would like to mention the German Science Council (DFG) which supported the first author when he visited the Leibniz Universität Hannover as Mercator Professor in 2015. The DFG also funded many grants of the second author for different projects on nonlinear finite element methods over the years. The results of

this work can be found at many different places throughout the book. Last but not least, we would like to thank the Springer Verlag for the pleasant collaboration during the past years.

Ljubljana
Hannover
March 2016

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<http://www.springer.com/978-3-319-39003-1>

Automation of Finite Element Methods

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2016, XXVIII, 346 p. 46 illus., 10 illus. in color.,

Hardcover

ISBN: 978-3-319-39003-1