INTRODUCTION

The selected chapters in the area of nonlinear problems in continuum mechanics presented on this page were gradually developed between 2009 and 2017 as supplementary extensions of the monograph [1]. They were initially created as separate sections focusing first on geometrically and physically nonlinear problems of bodies made from deformable materials and then extending to fluid flow, heat transfer, electromagnetism, contact between bodies, and acoustics. Because all these cases involve the investigation of a continuous continuum using the methods of continuum mechanics, the increasing number of supplements often led to the repetition of methods, formulas, and equations, as well as the frequent need to refer back to previous sections. This eventually inspired the idea to summarize this material in one place and make it accessible to interested readers on the Internet.

Linear problems in mechanics can now be solved almost routinely using commercial computational software with minimal—and unfortunately often underestimated—theoretical preparation on the part of the user. However, this is hardly conceivable for nonlinear problems. Even the input of data (such as material type, boundary conditions, convergence criteria, and selection of an appropriate computational model) and the ability to judge the reliability of the computed results require thorough theoretical and practical preparation.

The format of these supplements is mainly intended for application-oriented readers; therefore, most of the content illustrates the theory with examples and uses software tools to solve simple sample nonlinear problems. Applying the procedures and software to analogous real-world problems is usually just a matter of more labor-intensive editing of input data.

After the introductory theoretical sections, the issue at hand is addressed using numerical methods, primarily the finite element method (FEM), utilizing the programs Ansys Mechanical APDL and Ansys Fluent. Where possible, Mathematica 7 is used for the direct computation of the problem from the basic differential equations, and Matlab is used where appropriate for working with matrix equations.

References

[1] Benča, Š.: Solution of nonlinear strength problems using FEM. Slovak Technical University in Bratislava. Nakladateľstvo STU, Bratislava 2009. (in Slovak)