Preface

This book collects results presented at the *International Conference for Mathematical Modeling and Optimization in Mechanics (MMOM 2014) 6–7 March 2014, Jyväskylä, Finland,* which was dedicated to the 70th jubilee of Professor Nikolay Banichuk. The book consists of three parts: numerical analysis, mathematical modeling in mechanics, and optimization. This structure reflects the three main lines of the conference closely related to the scientific interests of Prof. Nikolay Banichuk and his colleagues.

Part I of the book contains four papers related to rather different but important problems in modern numerical analysis.

The first paper, by O. Pironneau, is devoted to highly nonlinear coupled models used for modeling of aortic flow. The paper combines analysis of viscous incompressible flow based on Navier–Stokes equations with ideas of shape optimization. Two next papers present new results on a posteriori error estimation methods for boundary value problems. The paper by O. Mali extends known a posteriori estimates of the functional type to the case of nonsymmetric elliptic operators. Another paper (by M. Nokka and S. Repin) is focused on applications of a posteriori estimates to iteration Uzawa methods for the stationary Bingham flow problem. The last paper in this part (by J.I. Toivanen) considers applications of the parametric level set method (which is one of the key tools of topology optimization) to methods of automatic differentiation. The author uses an adjoint approach to perform sensitivity analysis, but contrary to standard implementations the state problem is differentiated in its discretized form. The paper contains several examples demonstrating the performance of the method.

Part II collects the papers associated with mathematical modeling of mechanics.

It starts with the paper by Yuli D. Chashechkin, where the author discusses harmonization of analytical, numerical, and laboratory models of flows. This is mainly an overview paper aimed to present historical development of models and concepts in the theory of fluids. Other papers in this section are concerned with mathematical models of various mechanical and technological objects. Effects of friction in sliding contact of a sphere and a viscoelastic half space are studied in the

paper by I. Goryacheva, F. Stepanov, and E. Torskaya. Multiaxial fatigue criteria are used by N. Burago and I. Nikitin in an analysis of a complicated technical system. The paper by T. Saksa and J. Jeronen is devoted to dynamic analysis of viscoelastic Poynting Thompson beams. A projection approach to analysis of natural vibrations for beams with nonsymmetric cross-sections is presented in the paper by V. Saurin and G. Kostin. In the paper by N. Banichuk, A. Barsuk, J. Jeronen, P. Neittaanmäki, and T. Tuovinen, the authors consider bifurcation type problems arising in the theory of elastic stability.

Part III contains publications related to optimization methods.

The papers presented in this section can be classified into two groups. The first group mainly deals with optimization algorithms, while the second is more oriented to optimization and sensitivity analysis of engineering problems.

The first paper, by M.M. Mäkelä, N. Karmitsa and O. Wilppu, presents new algorithms of nonconvex multiobjective optimization based on the proximal bundle method. Parallelization of Nash genetic algorithms for solving inverse problems in structural engineering is discussed in the work of J. Périaux and D. Greiner.

A variant of variational design sensitivity analysis in structural optimisation using rigorous separation of physical quantities into geometry and displacement mappings is exposed in the paper by F.-J. Barthold, N. Gerzen, W. Kijanski, and D. Materna. The paper by G. Kostin and V. Saurin studies dynamics modeling and control design for elastic systems with distributed parameters, with the help of variational methods. Finally, contact optimization problems are considered in the work of I. Páczelt, A. Baksa, and Z. Mróz, and some problems of multipurpose optimization of deformed structures are investigated in the paper by A. Sinitsin, S. Ivanova, E. Makeev, and N. Banichuk.

The articles collected in the volume present only a part of the results of the conference. The editors tried to select contributions that are the most interesting. Some of them contain new results related to concrete mathematical or mechanical problems. Other articles were included by us because they overview the state of the art and discuss open questions related to a certain topic on mechanics, optimization methods, or modern technology. All the papers have been reviewed by two independent reviewers.

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Fig. 2 Participants