

Preface

*It's best to have failure happen early in life.
It wakes up the Phoenix bird in you so you rise from the ashes.*

Anne Baxter

We all hope for breakthrough rebirth moments.

Dane Cook

Evolutionary Algorithms and Metaheuristics are used extensively and with growing interest in wide areas of applied sciences and engineering for solving real application problems of interest in industry and society.

Particularly, in recent years, different MiniSymposium/Special Thematic Sessions focused on the area of “Civil Engineering and Construction Management” promoted by the editors of this book have attracted the attention of the scientific community in different European Community on Computational Methods in Applied Sciences (ECCOMAS) related conferences. Among them we should mention:

- “Applications in Structural and Civil Engineering Optimum Design”, MiniSymposium at the 10th International Conference on Evolutionary and Deterministic Methods for Design, Optimization and Control with Applications to Industrial and Societal Problems EUROGEN 2013, ECCOMAS Thematic Conference, Las Palmas de Gran Canaria, Spain, October 2013 (organized jointly also with Rajan Filomeno Coelho, Universite Libre de Bruxelles, Belgium).
- “Evolutionary Algorithms and Metaheuristics in Civil Engineering and Construction Management”, MiniSymposium at the 11th World Congress on Computational Mechanics WCCM—5th European Conference on Computational Mechanics ECCM, IACM—ECCOMAS, Barcelona, Spain, July 2014.
- “Evolutionary Algorithms and Metaheuristics in Civil Engineering and Construction Management”, Special Thematic Session at the Congress on Numerical Methods in Engineering organized by Sociedad Española de Métodos

Numéricos en Ingeniería SEMNI and Associação Portuguesa de Mecânica Teórica, Aplicada e Computacional APMTAC (Spanish and Portuguese Societies, respectively, integrated in ECCOMAS), Lisboa, Portugal, June–July 2015.

- “Evolutionary Algorithms and Metaheuristics in Civil Engineering and Construction Management”, MiniSymposium at the European Congress on Computational Methods in Applied Sciences and Engineering ECCOMAS 2016, Crete Island, Greece, June 2016.

Among the participants of these meetings, some selected contributions which constitute modified, extended, and improved versions of research have been collected in this volume. It presents up-to-date material on the state of the art in Evolutionary Algorithms and Metaheuristics in Civil Engineering and Construction Management from European contributors, being mainly oriented for researchers and postgraduate students who are familiar with the fundamentals and wish to study or to advance the state of the art on the field, although practicing engineers could benefit as well from it as there is a recent tendency of including evolutionary computation/metaheuristics as optimization tools in commercial design codes.

The book consists of 7 chapters (ordered alphabetically by first author surname), where problems of Civil Engineering are handled by using Evolutionary Algorithms and Metaheuristics as global optimization tools: structural mechanics problems are covered in Chaps. 1, 2 and 4–6, while in Chap. 3 a construction management problem is solved and in Chap. 7 an optimum design methodology of top-edge devices on noise barriers is introduced; the use of surrogate modeling/metamodels and other proposals oriented to reduce the number of real evaluations of the fitness function are taken into account in several chapters (1, 4 and 5); Chaps. 1 and 3 deal with multi-objective optimization, while Chaps. 2 and 4–7 solve single-objective optimization problems.

In Chap. 1, R. Filomeno Coelho et al., propose a complete metamodel-assisted optimization procedure to deal with mixed variables (including discrete, integer, or categorical data), which are required in complex civil engineering structural problems, by using a multi-objective evolutionary algorithm, a multiple kernel regression model, and an efficient online enrichment of the metamodel during the optimization.

In Chap. 2, D. Greiner et al. compare the truss structural optimum design problems of fully stressed design and minimum constrained weight, when using discrete cross-section type bar sizing. An analysis of whole search space in a simple truss test case is included, and optimization behavior of evolutionary algorithms with multiple population sizing and mutation rates is compared.

J. Magalhães-Mendes presents in Chap. 3 a new hybrid genetic algorithm for the time-cost optimization problem with application in construction projects. The approach was developed in Visual Basic language, applied to test problems reported on the literature and compared with other approaches.

Chapter 4 by J. Orkisz and M. Glowacki is devoted to efficiency increase of evolutionary algorithms for large nonlinear constrained optimization problems with applications to mechanics, which include: smoothing and balancing, adaptive

step-by-step mesh refinement, and a' posteriori error analysis and related techniques. It includes their application in residual stresses analysis in elastic-plastic bodies under cyclic loadings.

In Chap. 5, R. Paz et al. propose new optimization strategies based on genetic algorithms combined with surrogate models to reduce as much as possible the number of finite element method simulations in an additive manufacturing application, allowing minimization of weight by using internal cellular and lattice structures.

Chapter 6, by D. Ribeiro et al. deals with calibration methodologies of finite element numerical dynamic models of railway bridges, which imply the resolution of an optimization problem (solved using a genetic algorithm), including residuals associated to natural frequencies and mode shapes. It is applied to the calibration of dynamic models of two railway bridges in the northern line of Portuguese railways with excellent agreement between numerical and experimental responses of the bridges' decks.

The book closes with a procedure for improving the acoustic efficiency of top-edge devices on noise barriers by using the boundary element method (BEM) and genetic algorithms (Chap. 7, by R. Toledo et al.). Both thickness and non-thickness bodies are able to be modeled with a complementary formulation to the classical BEM, presenting here numerical results validating the formulation. Applications to quadratic residue diffuser design and to waterwheel-top barrier design are successfully obtained.

Evolutionary Algorithms and Metaheuristics are becoming an increasing key role in optimum design in many applied sciences and engineering fields, and this book focused on Civil Engineering and Construction Management applications is intended to increase this field interest and foster research in this particular area among the international and ECCOMAS community.

The book editors would like to express their deep appreciation to all contributors for the time and effort devoted to the completion of their contributions to this volume. Finally, the editors would like to thank the personnel of Springer for their most valuable support during the publication process.

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