Management and Industrial Engineering

Series editor

J. Paulo Davim, Aveiro, Portugal

More information about this series at http://www.springer.com/series/11690

Shubhabrata Datta · J. Paulo Davim
Editors

Optimization in Industry

Present Practices and Future Scopes

Springer

Editors
Shubhabrata Datta
Department of Mechanical Engineering
SRM Institute of Science and Technology
Chennai, India

J. Paulo Davim
Department of Mechanical Engineering
University of Aveiro
Aveiro, Portugal

ISSN 2365-0532 ISSN 2365-0540 (electronic)
Management and Industrial Engineering
ISBN 978-3-030-01640-1 ISBN 978-3-030-01641-8 (eBook)
https://doi.org/10.1007/978-3-030-01641-8

Library of Congress Control Number: 2018957251

This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Preface

Optimization is a standard activity in everyday life. We use it consciously or unconsciously for almost all our daily jobs. When we try to find a way to finish an assignment in our professional life in less effort or time, it is an optimization procedure. Deciding the best way to reach the workplace from the time and distance aspects, depending on the time of the day, is also an optimization. Many people in this world try to reduce the daily cost of living for their survival. All these actions have some amount of mental calculations behind it, and most of the time the calculation is not that mathematical. The optimization process basically finds the values of the variables those control the objective we need to optimize (i.e., minimize or maximize) while satisfying some constraints. This process becomes mathematical when we employ it in the professional sectors like finance, construction, manufacturing, etc. In those cases, the number of variables is quite high, and they are correlated in a complex way.

Mathematical optimization has various components. The first is the objective function, which defines the attribute to be optimized in terms of the dependent variables or design variables. For example, in manufacturing process, it describes the profit or the cost or the product quality. The design variables are the variables which control the value of the attribute, which is being optimized. The amounts of different resources used and the time spent in a manufacturing process may be considered as the design variables. The third important component in an optimization process is the constraint. It may be single or a set of constraints, which allow the process to take on certain values of the design variables but exclude others.

Among the different approaches of optimization, the classical derivative-based approaches were the most established and common optimization methods. But in recent years, advent of metaheuristic methods has changed the domain of optimization and made those methods more acceptable due to their ability to handle complex problems and lesser possibility of getting stuck in the local optima. A metaheuristic method has the strategy to guide and modify the pure heuristics to produce better solutions which are beyond the solutions generated in heuristic processes. The metaheuristic optimization algorithms consist of the evolutionary

algorithms, the swarm intelligence, other bio- and nature-inspired algorithms, and some Physics and process-based algorithms. In this book, most of the chapters deal with several case studies related to application of these metaheuristic algorithms in different domains of industry.

Optimizations methods are extensively being applied to different sectors of the industries and professional life, which includes the information system, the financial operations, the manufacturing systems, engineering design and design optimization, operations and supply chain management, internet of things, and multicriteria decision-making. Various metaheuristic optimization tools are being used in these spheres of life. In this book, after a brief description of the metaheuristic tools in the first chapter, eleven more chapters have been dedicated for dealing with such applications of the optimization techniques in industrially relevant fields. The authors from different countries have shared their experience in the optimization of systems like banking, steel making, manufacturing processes, electrical vehicles design, and civil constructions.

The editors express their gratitude to all the authors for their effort to make excellent contributions for the book. The editors are also grateful to all the reviewers who have taken the pain to improve the quality of the chapters further and make the book even better. The colleagues, friends, and family members of both the editors are gratefully acknowledged. The editors also acknowledge the brilliance of the Springer team shaping the compilation beautifully and express thanks to them.

Chennai, India — Shubhabrata Datta
Aveiro, Portugal — J. Paulo Davim

Contents

Optimization Techniques: An Overview 1
Shubhabrata Datta, Sandipan Roy and J. Paulo Davim

Evolutionary Computation for Multicomponent Problems: Opportunities and Future Directions 13
Mohammad Reza Bonyadi, Zbigniew Michalewicz, Markus Wagner and Frank Neumann

Evolutionary Computing Applied to Solve Some Operational Issues in Banks 31
Gutha Jaya Krishna and Vadlamani Ravi

Evolutionary Computation for Theatre Hall Acoustics 55
Cemre Cubukcuoglu, Ayca Kirimtat, Berk Ekici, Fatih Tasgetiren and P. N. Suganthan

Structural Optimization for Masonry Shell Design Using Multi-objective Evolutionary Algorithms 85
Esra Cevizci, Seckin Kutucu, Mauricio Morales-Beltran, Berk Ekici and M. Fatih Tasgetiren

Evolutionary Algorithms for Designing Self-sufficient Floating Neighborhoods 121
Ayca Kirimtat, Berk Ekici, Cemre Cubukcuoglu, Sevil Sariyildiz and Fatih Tasgetiren

Driving Assistance for Optimal Trip Planning of Electric Vehicle Using Multi-objective Evolutionary Algorithms 149
M. Khanra, A. K. Nandi and W. Vaz

Evolutionary Computation in Blast Furnace Iron Making 211
Bashista Kumar Mahanta and Nirupam Chakraboti

Data-Driven Design Optimization for Industrial Products 253
Swati Dey, N. Gupta, S. Pathak, D. H. Kela and Shubhabrata Datta

Intuitionistic Fuzzy Approach Toward Evolutionary Robust Optimization of an Industrial Grinding Operation Under Uncertainty 269
Nagajyothi Virivinti and Kishalay Mitra

Optimisation in Friction Stir Welding: Modelling, Monitoring and Design 299
Qian Zhang and Xiaoxiao Liu

Comparative Study of Multi/Many-Objective Evolutionary Algorithms on Hot Rolling Application 331
Prateek Mittal, Affan Malik, Itishree Mohanty and Kishalay Mitra

Index 351

About the Editors

Shubhabrata Datta, presently Research Professor in the Department of Mechanical Engineering, SRM Institute of Science and Technology, Chennai, India, did his Bachelors, Masters, and Ph.D. in Engineering from Indian Institute of Engineering Science and Technology, Shibpur, India in the field of Metallurgical and Materials Engineering. He has more than 25 years of teaching and research experience. His research interest is in the area of modeling and optimization in engineering systems, with an emphasis to design of materials using computational intelligence techniques. He has more than 125 publications in journals and peer-reviewed conference proceedings. He was conferred with Exchange Scientist Award from Royal Academy of Engineering, UK and worked in the University of Sheffield, UK. He also worked in Dept of Materials Science and Engineering, Helsinki University of Technology, Finland, Dept of Materials Science and Engineering, Iowa State University, Ames, USA and Heat Engineering Lab, Dept of Chemical Engineering, Åbo Akademi University, Finland as Visiting Scientist. He is a Fellow of Institution of Engineers (India), and Life Member, Materials Research Society of India. He is the Associate Editor, Journal of the Institution of Engineers (India): Series D, Member, Editorial Board of International Journal of Materials Engineering Innovation and Member, Editorial Review Board, International Journal of Surface Engineering and Interdisciplinary Materials Science.

J. Paulo Davim received his Ph.D. in Mechanical Engineering in 1997, M.Sc. in Mechanical Engineering (materials and manufacturing processes) in 1991, Mechanical Engineering (5 years) in 1986 from the University of Porto (FEUP), the Aggregate title (Full Habilitation) from the University of Coimbra in 2005, and D.Sc. from London Metropolitan University in 2013. He is Eur Ing by FEANI-Brussels and Senior Chartered Engineer by the Portuguese Institution of Engineers with an MBA and Specialist title in Engineering and Industrial Management. Currently, he is Professor at the Department of Mechanical Engineering of the University of Aveiro, Portugal. He has more than 30 years of teaching and research experience in Manufacturing, Materials, Mechanical and Industrial Engineering, with special emphasis in Machining & Tribology. He also

has interest in Management, Engineering Education and Higher Education for Sustainability. He has guided large numbers of postdoc, Ph.D., and master's students as well as has coordinated and participated in several financed research projects. He has received several scientific awards. He has worked as evaluator of projects for international research agencies as well as examiner of Ph.D. thesis for many universities in different countries. He is the Editor in Chief of several international journals, Guest Editor of journals, books Editor, book Series Editor, and Scientific Advisory for many international journals and conferences. Presently, he is an Editorial Board member of 25 international journals and acts as reviewer for more than 80 prestigious Web of Science journals. In addition, he has also published as editor (and co-editor) more than 100 books and as author (and co-author) more than 10 books, 80 book chapters, and 400 articles in journals and conferences (more than 200 articles in journals indexed in Web of Science core collection/h-index 47+/6500+ citations and SCOPUS/h-index 54+/9000+ citations).