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Advanced Modeling and Optimization of Manufacturing Processes

International Research and Development

Springer

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ISSN 1860-5168

ISBN 978-0-85729-014-4 e-ISBN 978-0-85729-015-1

DOI 10.1007/978-0-85729-015-1

Springer London Dordrecht Heidelberg New York

British Library Cataloguing in Publication Data
A catalogue record for this book is available from the British Library

Library of Congress Control Number: 2010937562

Cover design: eStudio Calamar, Berlin/Figueres

Printed on acid-free paper

Springer is part of Springer Science+Business Media (www.springer.com)

Dedicated to my parents (*Lakshmi Narayana and Jayamma*), *dearest wife* (*Sujatha Rao*), *and beloved daughter* (*Jaya Lakshmi*)

Preface

Manufacturing includes various types of processes and today's manufacturing processes are caught between the growing needs for quality, high process safety, minimal manufacturing costs, and short manufacturing times. In order to meet the demands, manufacturing process setting parameters have to be chosen in the best possible way. The selection of optimum process parameters plays a significant role to ensure quality of product, to reduce the manufacturing cost and to increase productivity in computer controlled manufacturing process. For such optimization it is necessary to represent the manufacturing process in a model. However, the primary challenge for manufacturing process optimization often stems from the fact that the procedure is typically highly constrained and highly non-linear. Additionally, manufacturing process models are likely discontinuous, non-explicit, or not analytically differentiable with the design variables. Due to the enormous complexity of many manufacturing processes and the high number of influencing parameters, conventional approaches to modeling and optimization are no longer sufficient. Advanced modeling and optimization techniques are needed to be developed and used as modeling and optimization of manufacturing process is becoming increasingly important in industry in the drive towards 'agile manufacturing'.

The purpose of this book is to present a comprehensive review on latest research and development trends at international level for modeling and optimization of various manufacturing processes, particularly the machining processes which are the most frequently analyzed manufacturing processes. Using examples of various processes, the possibilities for process modeling and optimization with advanced modeling and optimization techniques are demonstrated. The book presents thorough literature of various manufacturing processes, mathematical models, traditional and non-traditional optimization techniques, real case studies, results of applications of the proposed methods, and highlights the best modeling and optimization strategies to achieve best process performance. The algorithms and computer codes for meta-heuristic optimization techniques included in the book will be very much useful to the readers.

The book is expected to be very useful to the designers and manufacturing engineers in the manufacturing sector who are responsible for the technical aspects of realizing a product as it presents new models and optimization techniques to make their tasks easier, logical, efficient and effective. The book is intended for designers, manufacturing engineers, practitioners, managers, institutes involved in design and manufacturing related projects, applied research workers, academics, and graduate students in mechanical, industrial, and manufacturing engineering.

I am grateful to Anthony Doyle and Claire Protherough of Springer-Verlag, London, for their support and help in producing this book. I wish to thank various researchers and the publishers of international journals for giving me the permission to reproduce certain portions of their published research works. I gratefully acknowledge the support of my research scholars Mr. P. J. Pawar, Mr. B. K. Patel, and Mr. V. K. Patel. My special thanks are due to the Director, Registrar (Mr H. A. Parmar) and my colleagues at S.V. National Institute of Technology.

While every attempt has been made to ensure that no errors (printing or otherwise) enter the book, the possibility of these creeping into the book is always there. I will be grateful to the readers if these errors are pointed out. Suggestions for further improvement of the book will be thankfully acknowledged.

Surat, June 2010 R. Venkata Rao

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