Multi-Objective Optimization in Chemical Engineering

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Developments and Applications

Edited by

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Preface

The optimization approach is well established in both academia and in industrial practice with numerous applications in chemical engineering. Several tools are readily available for process optimization. However, optimization applications often have more than one objective, which requires Multi-Objective Optimization (MOO). Since the early 2000s, MOO has grown significantly as an effective and useful approach, especially for process optimization in chemical engineering. In particular, current technologies and requirements in the petrochemical, chemical, biotechnology, energy and other emerging industries have imposed new challenges to the field of MOO. These challenges are due to the necessity of solving complex design-optimization problems that involve several objectives, many decision variables and constraints. To date, there have been many theoretical and computational developments in MOO and its applications for solving these complex problems of modern industry. Yet, in spite of many advances and applications of MOO, there is only one book specifically devoted to MOO techniques and their applications in chemical engineering. This earlier book, edited by Rangaiah and published in 2009, describes selected MOO techniques and a number of application problems.

The present book on MOO covers the most recent developments in and novel applications of MOO, for modeling and solving a variety of challenging case studies in different areas of chemical engineering. In particular, this book covers new MOO methods and ideas that have not been introduced in earlier MOO books. It is a collection of contributions from the leading chemical engineering researchers on MOO and its applications. Every chapter in this book has been reviewed anonymously by at least two experts, and then thoroughly revised by the respective contributors. The review process for chapters co-authored by each of the editors has been entirely handled by the other editor. Through this rigorous review, every attempt has been made to maintain the high-quality and educational value of the contributions.

This book is organized into three parts. Part I (Chapters 1–3) provides the introduction, one important application of MOO, and an overview of chemical engineering applications of MOO since the year 2007. New algorithm developments and state-of-the-art techniques used for solving MOO problems are presented in Part II (Chapters 4–8). Finally, Chapters 9–17, in Part III, deal with various MOO application studies from thermodynamics, petrochemical, environmental, biofuels and other chemical engineering areas. These illustrate the applicability and advantages of MOO in process systems engineering within chemical engineering. A number of chapters have exercises at the end, and the material in some chapters is complemented by relevant and useful programs/files available on the book's web site (http://booksupport.wiley.com; enter the book's title, editor names or ISBN to access this).

Multi-Objective Optimization in Chemical Engineering will be useful for researchers, practitioners and postgraduate students interested in the area of MOO. Chapters can be readily adopted as part of advanced courses on optimization for senior undergraduate and postgraduate students. They will also allow the readers to adapt and apply available techniques to their processes or specific problems. In general, readers can choose the chapters of interest and read them independently.

We are grateful to all the contributors and the reviewers of the chapters for their cooperation in meeting the requirements and schedule to finalize the book. In particular, we thank Prof. S.K. Gupta, Prof. J. Thibault and Prof. A.F.A. Hoadley for their timely help in reviewing some chapters authored by the editors. Special thanks are due to Shivom Sharma and Gudena Krishna, who assisted us in preparing and submitting the final files to the publisher. Finally, we would like to thank Ms. Sarah Tilley, Ms. Emma Strickland and Ms. Rebecca Stubbs of John Wiley & Sons, Ltd, for their cooperation and promptness in producing this book.

Research in MOO will continue to be an active area in chemical engineering, and we hope that this book will contribute to further developments in this topic.

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