

# Foreword

The primary aim of this book, *Multi-Objective Optimization of Industrial Power Generation Systems: Emerging Research and Opportunities* is to provide insights on the implementation of current multi-objective (MO) optimization techniques to application problems in power engineering. This book provides recent developments of computational intelligence in the power generation industry covering bioenergy, solar power, distributed generation, coal power, hydro and hydrothermal systems, gas turbine plants, combined cycle systems and nuclear plants. In addition, the book primarily focuses on complex MO optimization problems involving: solar power technologies, industrial gas turbine systems and biofuel supply chains. This book is invaluable for readers serving as a guideline to conduct research and tackle real-world industrial MO problems in the energy industry. It provides algorithmic details on current state-of-the-art MO optimization techniques applied in the power industry - the results of these implementations are also critically analyzed and discussed throughout the book.

This book blazes the trail for emerging research areas in MO techniques - e.g. evolutionary algorithms, swarm intelligence as well as symbolic programming paradigms (analytical and genetic programming). The author introduces fundamental elements, computational procedures and detail industrial applications in MO optimization. These factors provide the essential tools and 'know-hows' for building and applying efficient MO algorithms. In power generation, practical utilization of MO techniques has become of utmost importance providing various advantages to organization and decision makers globally. Among these advantages are; timely delivery of service, adherence to service level agreements (SLA), optimization of existing systems, improved utilization of resources and efficient system management.

Another key contribution of this book is the novel ideas presented on improving existing methodologies in MO optimization. For instance, in

Chapter 2, a Type-2 Fuzzy Logic approach was utilized in the MO solar irrigation problem (which was plagued by uncertainties). In the design of alternative energy systems such as solar technologies, the engineer/decision maker would often encounter noise sources when their system interacts with the environment (e.g. solar insolation and ambient temperature fluctuations). The author presents a novel idea where a generalized problem is constructed and solved within a Type-2 Fuzzy formulation.

In Chapter 3, a chaos-based mechanism was employed to enhance the differential evolution computational technique. By manipulating the chaos levels of the solution method, the optimization efforts was seen to significantly improve. The interesting concept of stochastic engines is introduced and employed in Chapter 4 for tackling the gas turbine waste heat recovery MO optimization problem. There the author shows that each stochastic engine uniquely influences the optimization results - when applied to highly complex problems (MO problems with four or more objective functions). In that chapter, the idea of manipulating the factors in stochastic engines is given (probability distribution; shape, scale and location) with the idea of improving their effectiveness.

In Chapters 5 and 6, Lévy flight enhancements and random matrices were incorporated into the optimization strategies for solving the high-complexity biofuel supply chain problem. These novel frameworks inspire further research works and pushes the limits of conventional solution strategies in MO optimization.

This valuable volume consists of the following research goals, topics and techniques:

- It provides comprehensive guidelines for engineers/decision makers for building algorithmic solution methods for MO optimization of power generation systems.
- It explores various MO settings and scenarios in real-world industrial power generation systems.
- It discusses and critically analyzes the results obtained from the application of different types of solutions strategies - and the impacts of algorithmic enhancements on the optimization results (positive and negative impacts).
- It also supplies the reader with some of the behaviors and characteristics of the computational method during execution on these industrial problems.

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- It provides the reader with potential research directions and ideas for constructing interesting hypotheses for further numerical experimentations.

MO applications using computational intelligence, specifically metaheuristics are currently growing at an unprecedented level. These applications range broadly across various industrial engineering sectors: supply chain management, system design, operations/maintenance, risk/reliability engineering, control systems, process modelling, energy optimization and resource utilization. Although this book focuses on three specific applications: solar power technologies, industrial gas turbine systems and biofuel supply chains, the solution strategies and the ‘thinking framework’ utilized in this book could be extended to other areas in industrial engineering.

The discussions provided by the author are rich and multifaceted covering various aspects of industrial applications as well as solution strategies. The variety of topics covered in this book is extracted from the author’s vast experience in various research works in MO industrial optimization. The author combines two styles. The first is a ‘data-driven’ approach which emerges from a ‘problem-based solution’ philosophy frequently used in engineering and the applied sciences. The second one is a ‘theoretical model-centric approach’ springing from fundamentals in mathematics and physics - where he wields diverse mathematical tools from highly theoretical fields. This blend of styles is very suitable when dealing with complex problems as encountered in this book as well as problems where the lines between theory and application are blurred.

To the author of the book, Timothy Ganesan, we would like to extend our gratitude and appreciation for utilizing your analytical skills, expertise and research experience to generate this volume - which is invaluable for other researchers and decision makers in academia and industry alike. We are also thankful to the publisher IGI Global for providing an avenue for experts like the author to publish their current developments and emerging research methodologies - helping them increase the accessibility of their work to a larger scientific community.

To the reader, we wish that upon reading this book you will gain invaluable insights and useful knowledge - most importantly we wish that you obtain the knowledge to build effective techniques and tools for solving a vast array of problems in industrial optimization. Moreover, the content of this book

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will provide holistic and break through global framework and insight new knowledge for the international research scholars across the planet.

Sincerely,

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