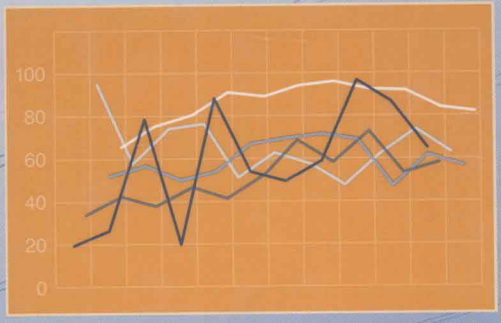
Optimization of Power System Operation

Jizhong Zhu



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Mohamed E. El-Hawary, *Series Editor*

OPTIMIZATION OF POWER SYSTEM OPERATION

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To My Wife and Son

PREFACE

I have been undertaking the research and practical applications of power system optimization since the early 1980s. In the early stage of my career, I worked in universities such as Chongqing University (China), Brunel University (UK), National University of Singapore, and Howard University (USA). Since 2000 I have been working for AREVA T&D Inc (USA). When I was a full-time professor at Chongqing University, I wrote a tutorial on power system optimal operation, which I used to teach my senior undergraduate students and postgraduate students in power engineering until 1996. The topics of the tutorial included advanced mathematical and operations research methods and their practical applications in power engineering problems. Some of these were refined to become part of this book.

This book comprehensively applies all kinds of optimization methods to solve power system operation problems. Some contents are analyzed and discussed for the first time in detail in one book, although they have appeared in international journals and conferences. These can be found in Chapter 9 "Steady-State Security Regions", Chapter 11 "Optimal Load Shedding", Chapter 12 "Optimal Reconfiguration of Electric Distribution Network", and Chapter 13 "Uncertainty Analysis in Power Systems."

This book covers not only traditional methods and implementation in power system operation such as Lagrange multipliers, equal incremental principle, linear programming, network flow programming, quadratic programming, nonlinear programming, and dynamic programming to solve the economic dispatch, unit commitment, reactive power optimization, load shedding, steady-state security region, and optimal power flow problems, but also new technologies and their implementation in power system operation in the last decade. The new technologies include improved interior point method, analytic hierarchical process, neural network, fuzzy set theory, genetic algorithm, evolutionary programming, and particle swarm optimization. Some new topics (wheeling model, multiarea wheeling, the total transfer capability computation in multiareas, reactive power pricing calculation, congestion management) addressed in recent years in power system operation are also dealt with and put in appropriate chapters.

In addition to having the rich analysis and implementation of all kinds of approaches, this book contains much hand-on experience for solving power system operation problems. I personally wrote my own code and tested the presented algorithms and power system applications. Many materials presented in the book are derived from my research accomplishments and publications when I worked at Chongqing University, Brunel University, National University of Singapore, and Howard University, as well as currently with AREVA T&D Inc. I appreciate these organizations for providing me such good working environments. Some IEEE papers have been used as primary sources and are cited wherever appropriate. The related publications for each topic are also listed as references, so that those interested may easily obtain overall information.

I wish to express my gratitude to IEEE book series editor Professor Mohammed El-Hawary of Dalhousie University, Canada, Acquisitions Editor Steve Welch, Project Editor Jeanne Audino, and the reviewers of the book for their keen interest in the development of this book, especially Professor Kit Po Wong of the Hong Kong Polytechnic University, Professor Loi Lei Lai of City University, UK, Professor Ruben Romero of Universidad Estadual Paulista, Brazil, and Dr. Ali Chowdhury of California Independent System Operator, who offered valuable comments and suggestions for the book during the preparation stage.

Finally, I wish to thank Professor Guoyu Xu, who was my PhD advisor twenty years ago at Chongqing University, for his high standards and strict requirements for me ever since I was his graduate student. Thanks to everyone, including my family, who has shown support during the time-consuming process of writing this book.

JIZHONG ZHU

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