

Preface

Network design optimization is basically a fundamental issue in various fields, including applied mathematics, computer science, engineering, management, and operations research. Network models provide a useful way for modeling various real world problems and are extensively used in many different types of systems: communications, mechanical, electronic, manufacturing and logistics. However, many practical applications impose on more complex issues, such as complex structure, complex constraints, and multiple objectives to be handled simultaneously and make the problem intractable to the traditional approaches.

Recent advances in evolutionary algorithms (EAs) focus on how to solve such practical network optimization problems. EAs are stochastic algorithms whose search strategies model the natural evolutionary phenomena; genetic inheritance and Darwinian strife for survival. Usually it is necessary to design a problem-oriented algorithm for the different types of network optimization problems according to the characteristics of the problem to be treated. Therefore, how to design efficient algorithms suitable for complex nature of network optimization problems is the major focus of this research work. Generally, EAs involve following metaheuristic optimization algorithms, such as genetic algorithm (GA), evolutionary programming (EP), evolution strategy (ES), genetic programming (GP), learning classifier systems (LCS), and swarm intelligence (comprising ant colony optimization: ACO and particle swarm optimization: PSO). Among them, genetic algorithms are perhaps the most widely known type of evolutionary algorithms today.

In the past few decades, the study on how to apply genetic algorithms to problems in the industrial engineering world has aroused a great deal of curiosity of many researchers and practitioners in the area of management science, operations research and industrial and systems engineering. One major reason is that genetic algorithms are powerful and broadly applicable stochastic search and optimization techniques, and work well for many complex problems which are very difficult to solve by conventional techniques. Many engineering problems can be regarded as a kind of network type based optimization problems subject to complex constraints. Basic genetic algorithms usually fail to produce successful applications for these thorny engineering optimization problems. Therefore, how to tailor genetic algo-

rithms to meet the nature of these problems is a major focus in this research. This book is intended to cover major topics of the research on application of the multiobjective genetic algorithms to various network optimization problems, including basic network models, logistics network models, communication network models, advanced planning and scheduling models, project scheduling models, assembly line balancing models, tasks scheduling models, and advanced network models.

Since early 1993, we have devoted our efforts to the research of genetic algorithms and its application to optimization problems in the fields of industrial engineering (IE) and operational research (OR). We have summarized our research results in our two early books entitled *Genetic Algorithms and Engineering Design*, by John Wiley & Sons, 1997 and *Genetic Algorithms and Engineering Optimization*, by John Wiley & Sons, 2000, covering the following major topics: constrained optimization problems, combinatorial optimization problems, reliability optimization problems, flowshop scheduling problems, job-shop scheduling problems, machine scheduling problems, transportation problems, facility layout design problems, and other topics in engineering design.

We try to summarize our recent studies in this new volume with the same style and the same approach as our previous books with the following contents: multiobjective genetic algorithms, basic network models, logistics network models, communication network models, advanced planning and scheduling models, project scheduling models, assembly line balancing models, tasks scheduling models and advanced network models. This book is suitable for a course in the network model with applications at the upper-level undergraduate or beginning graduate level in computer science, industrial and systems engineering, management science, operations research, and related areas. The book is also useful as a comprehensive reference text for system analysts, operations researchers, management scientists, engineers, and other specialists who face challenging hard-to-solve optimization problems inherent in industrial engineering/operations research.

During the course of this research, one of the most important things is to exchange new ideas on the latest developments in the related research fields and to seek opportunities for collaboration among the participants and researchers at conferences or workshops. One of the authors, Mitsuo Gen, has organized and founded several conferences/workshops/committees on evolutionary computation and its application fields such as C&IE (International Conference on Computers and Industrial Engineering) in Japan 1994 and in Korea 2004, IMS (International Conference on Information and Management Science) in 2001 with Dr. Baoding Liu, IES (Japan-Australia Joint Workshop on Intelligent and Evolutionary Systems) in 1997 with Dr. Xin Yao, Dr. Bob McKay and Dr. Osamu Katai, APIEMS (Asia Pacific Industrial Engineering & Management Systems) Conference with Dr. Hark Hwang and Dr. Weixian Xu in 1998, IML (Japan-Korea Workshop on Intelligent Manufacturing and Logistics Systems) in 2003, ILS (International Conference on Intelligent Logistics Systems) in 2005 with Dr. Kap Hwan Kim and Dr. Erhan Kosan and ETA (Evolutionary Technology and Applications) Special Interest Committee of IEE Japan in 2005 with Dr. Osamu Katai, Dr. Hiroshi Kawakami and Dr. Yasuhiro Tsujimura. All of these conferences/workshops/committees are continuing

right now to develop our research topics with face to face contact. Dr. Gen called on additional conference, ANNIE2008 (Artificial Neural Networks in Engineering; Intelligent Systems Design: Neural Networks, Fuzzy Logic, Evolutionary Computation, Swarm Intelligence, and Complex Systems) organized by Dr. Cihan Dagli from 1990, as one of Co-chairs. He gave tutorials on genetic algorithms twice and a plenary talk this year.

It is our great pleasure to acknowledge the cooperation and assistance of our colleagues. Thanks are due to many coauthors who worked with us at different stages of this project: Dr. Myungryun Yoo, Dr. Seren Ozmehmet Tasan and Dr. Azuma Okamoto. We would like to thank all of our graduate students, especially, Dr. Gengui Zhou, Dr. Chiung Moon, Dr. Yinzhen Li, Dr. Jong Ryul Kim, Dr. YongSu Yun, Dr. Admi Syarif, Dr. Jie Gao, Dr. Haipeng Zhang and Mr. Wenqiang Zhang and Ms. Jeong-Eun Lee at Soft Computing Lab. at Waseda University, Kyushu campus and Ashikaga Institute of Technology, Japan.

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