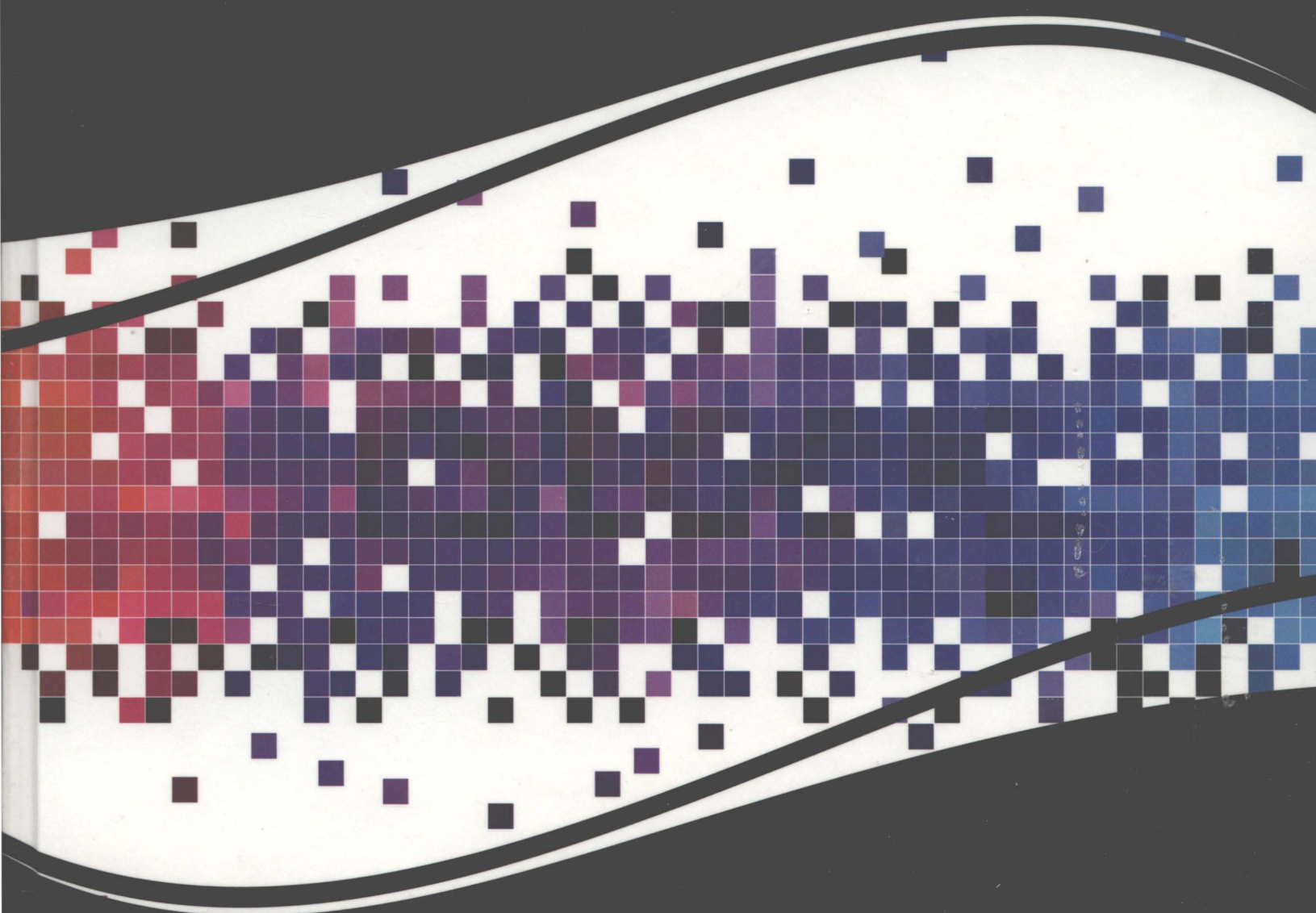


Handbook of Research on

Modern Optimization Algorithms and Applications in Engineering and Economics



Pandian Vasant, Gerhard-Wilhelm Weber, and Vo Ngoc Dieu

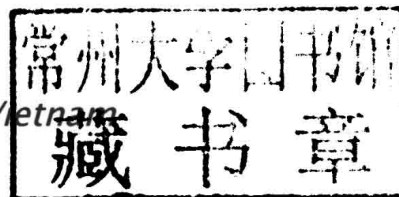


Handbook of Research on Modern Optimization Algorithms and Applications in Engineering and Economics

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A volume in the Advances in Computational
Intelligence and Robotics (ACIR) Book Series



An Imprint of IGI Global

Published in the United States of America by
Engineering Science Reference (an imprint of IGI Global)
701 E. Chocolate Avenue
Hershey PA, USA 17033
Tel: 717-533-8845
Fax: 717-533-8661
E-mail: cust@igi-global.com
Web site: <http://www.igi-global.com>

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Library of Congress Cataloging-in-Publication Data

Names: Vasant, Pandian, editor. | Weber, Gerhard-Wilhelm, editor. | Dieu, Vo Ngoc, 1971- editor.

Title: Handbook of research on modern optimization algorithms and applications in engineering and economics / Pandian Vasant, Gerhard-Wilhelm Weber, and Vo Ngoc Dieu, editors.

Description: Hershey : Information Science Reference, 2016. | Includes bibliographical references and index.

Identifiers: LCCN 2015037648 | ISBN 9781466696440 (hardcover) | ISBN 9781466696457 (ebook)

Subjects: LCSH: Mathematical optimization. | Algorithms.

Classification: LCC QA402.5 .H3655 2016 | DDC 330.01/5196--dc23 LC record available at <http://lccn.loc.gov/2015037648>

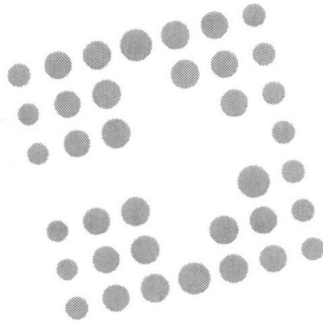
This book is published in the IGI Global book series Advances in Computational Intelligence and Robotics (ACIR) (ISSN: 2327-0411; eISSN: 2327-042X)

British Cataloguing in Publication Data

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

All work contributed to this book is new, previously-unpublished material. The views expressed in this book are those of the authors, but not necessarily of the publisher.

For electronic access to this publication, please contact: eresources@igi-global.com.



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ISSN: 2327-0411
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Engineering Science Reference • copyright 2015 • 743pp • H/C (ISBN: 9781466682917) • US \$335.00 (our price)



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With the rise of large city and the need of large civil engineering structures and city planning, surveying industry improves continuously their instruments/software in order to get cm accuracy position anywhere. Moreover, since the boom of mobile phones in the late 90s, location has become very valuable information for security, emergency and commercial applications. Depending of the application, the location technologies vary based on the accuracy of the location and the price of the system, which delivers the location information to the user. For outdoor applications, Global Navigation Satellite System is the main candidate, whereas if the user/mobile node is indoors or in a narrow street other technologies will be preferred such as the ones based on Wi-Fi or radio-frequency signal. This chapter provides an overview of different positioning technologies used in geo-location together with their limits/advantages. This chapter studies also a number of algorithms developed to estimate the position coordinates of a static or mobile user or target.

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Supply chain network design is one of the most important strategic issues in operations management. The main objective in designing a supply chain is to keep the cost as low as possible. However, the modelling of a supply chain requires more than single-objective such as lead-time minimization, service level maximization, and environmental impact maximization among others. Usually these objectives may cause conflicts such as increasing the service level usually causes a growth in costs. Therefore, the aim should be to find trade-off solutions to satisfy the conflicting objectives. The aim of this chapter is to propose a new method based on a hybrid version of the Bees Algorithm with Slope Angle Computation and Hill Climbing Algorithm to solve a multi-objective supply chain network design problem. A real case from the literature has been selected and solved in order to show the potentiality of the proposed method in solving a large scale combinatorial problem.

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<i>Judy A. Perkins, Prairie View A&M University, USA</i>	
<i>Tierney Moore, Prairie View A&M University, USA</i>	

Over the years the supply chain industry has been transforming to improve the end-to-end (production to delivery) process. Supply chain management (SCM) allows various industries to oversee and better handle how their product is manufactured and delivered. It allows them to track and identify the location of the product and to be more efficient in delivery. Integrating total asset visibility (TAV) technology into the supply chain structure can provide excellent visibility of a product. This kind of visibility complemented with various packaging schemes can assist in accommodating optimization strategies for visualizing the movement of a product throughout the entire supply chain pipeline. The chapter will define SCM, discuss TAV, review how transportation as well as optimization impacts SCM and TAV, and examine the role of packaging in the context of SCM and TAV.

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In this article it is studied the application of a genetic algorithm in the problem of variable selection for multiple linear regression, minimizing the least squares criterion. The algorithm is based on a chromosomic representation of variables that are considered in the least squares model. A binary chromosome indicates

the presence (1) or absence (0) of a variable in the model. The fitness function is based on the adjusted square R, proportional to the fitness for chromosome selection in a roulette wheel model selection. Usual genetic operators, such as crossover and mutation are implemented. Comparisons are performed with benchmark data sets, obtaining satisfying and promising results.

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An Application of Alpha-Stable Distributions for the Economic Analysis of Unit Commitment 160

Jose Antonio Marmolejo, Anahuac University, Mexico

Román Rodríguez, National Polytechnic Institute, Mexico

In power systems, we still lack the existence of standardized test systems that can be used to benchmark the performance and solution quality of proposed optimization techniques. It is therefore necessary to develop new methods for design of test cases for economic analysis in power systems. We compared two methods to generate test systems: time series and a method for simulating stable random variables that can be used to multiperiod unit commitment based on the use of Chambers-Mallows-Stuck. Hence, after comparing both methods, we describe the method for simulating stable random variables in the generation of test systems for economic analysis in power systems. A study focused on generating test electrical systems through fat tail model for unit commitment problem in electrical power systems is presented. Usually, the instances of test systems in Unit Commitment are generated using normal distribution, but in this work, simulations data are based on alpha-stable distribution. Numerical results illustrate the applicability of the proposed method.

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Francisco Venegas Martínez, Instituto Politécnico Nacional, Mexico

Elvia Pérez Ramírez, Universidad Nacional Autónoma de México, Mexico

In real-world most of manufacturing systems are large, complex, and subject to uncertainty. This is mainly due to events as random demands, breakdowns, repairs of production machines, setup and cycle times, inventory fluctuations and more. If items move too quickly, workers may work too hard. If items move too slowly, workers may have great leisure times. However, must make decisions here and now regarding the operation of the system optimally and quickly. In practice, these decisions are based on recent statistics of the system behavior, in the experience of the analyst and the urgency of the solution. In this chapter, we present a real problem associated with the production of individual parts in metalworking industry for the refrigerators production. We develop a model based on the Markov Decision Process to study the dynamics of the trajectory of end products in a manufacturing line that works by process. Then, we propose a measure of the average production rate of the line by using the Monte Carlo method. We illustrate our proposal using a numerical example with real data obtained in situ.

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Fernando Tohmé, Universidad Nacional del Sur, Argentina & CONICET, Argentina

Fabio Miguel, Universidad Nacional de Río Negro, Argentina

This chapter addresses the family of problems known in the literature as Capacitated Vehicle Routing Problems (CVRP). A procedure is introduced for the optimization of a version of the generic CVRP. It generates feasible clusters and, in a first step, yields a coding of their ordering. The next stage provides this information to a genetic algorithm for its optimization. A selective pressure process is added in order to improve the selection and subsistence of the best candidates. This arrangement allows improving the performance of the algorithm. We test it using Van Breedam and Taillard's problems, yielding similar results as other algorithms in the literature. Besides, we test the algorithm on real-world problems, corresponding to an Argentinean company distributing fresh fruit. Four instances, with 50, 100, 150 and 200 clients were examined, giving better results than the current plans of the company.

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Sotirios K. Goudos, Aristotle University of Thessaloniki, Greece

Katherine Siakavara, Aristotle University of Thessaloniki, Greece

John N. Sahalos, Aristotle University of Thessaloniki, Greece

In this chapter, the Artificial Bee Colony (ABC) algorithm and its variants are presented and applied to spiral antennas design for RFID tag application at the UHF band. The ABC variants include the Improved ABC (I-ABC), which is an improved version of the original ABC algorithm. The I-ABC introduces the best-so-far solution, inertia weight and acceleration coefficients to modify the search process. Furthermore, another ABC variant is the Gbest ABC (ABC), which includes global best (gbest) solution information into the search equation to improve the exploitation. These algorithms are applied to antenna design where the optimization goals are antenna size minimization, gain maximization, and conjugate matching. The algorithms performance is compared with other popular evolutionary algorithms. The optimization results produced show that the ABC family of algorithms is a powerful tool that can be efficiently applied to antenna design problems.

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Enrique Gabriel Baquela, Universidad Tecnológica Nacional, Argentina

Ana Carolina Olivera, Universidad Nacional de la Patagonia Austral, Argentina &

CONICET, Argentina

In this chapter the application of a nature-inspired technique in conjunction with simulation models to optimize the siting of concentration nodes in a traffic network of urban area is presented. The solutions of this optimization problem involve the redesign of the network by adding nodes and arcs to the current

traffic network. The problem is a sub-problem of the most general “Traffic Network Design Problem”. For this resolution a Genetic Algorithm approach was design and development. The popular Simulator of Urban Mobility (SUMO) is use as traffic simulator in order to evaluate the solutions obtained. This chapter contains the conceptual models and the results of the Optimization via Simulation technique proposed.

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<i>Dieu Ngoc Vo, Ho Chi Minh University of Technology, Vietnam</i>	
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This chapter proposes a Hybrid Cuckoo search algorithm to determine optimal location and sizing of Static VAR Compensator (SVC). Hybrid Cuckoo search algorithm is a simple combination of the Cuckoo search algorithm (CSA) and Teaching-learning-based optimization (TLBO), where the learner phase of TLBO is added to improve performance of Cuckoo eggs. The proposed method is applied for optimizing location and sizing of SVC in electric power system. This problem is a kind of discrete and combinatorial problem. The objective function considers loss power, voltage deviation and operational cost of SVC and other operating constraints in power system. Numerical results from three various tested systems show that the proposed method is better than the conventional CSA and TLBO in finding the global optimum solutions and its performance is also high than others.

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In cases where the size and colour of cable are changed, the cable industry is classified as a multi-product, mass production system. The paper provides a mixed integer linear programming model based on continuous time representation for a case study on the scheduling problem of the cable industry to minimize the total cost including setup cost, operating cost, and inventory holding cost. As the solution methodology, three grouping policies are proposed while Xpress solver could not give any feasible solution for the model. Cables of the same size and the same colour, respectively, of the different types of cable are grouped together. A metaheuristic based on a simulated annealing algorithm is applied to minimize the total cost of proposed solutions. Finally the solution with the smallest total cost is selected as the production schedule of the study case.

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The second approach, for sequences with consistency, deals with a hybrid GA based on the Divide and Conquer principle (DCP) and it can save space. A consistent dot matrices (CDM) algorithm discovers consistency and creates MSA. The proposed GA (GA_TS_VS) also uses TS but it works with partitions. In conclusion, GAs are stochastic approaches that are proved very beneficial for MSA in terms of their performance.

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Thang Trung Nguyen, Ton Duc Thang University, Vietnam

Dieu Ngoc Vo, Ho Chi Minh City University of Technology, Vietnam

This chapter proposes a Cuckoo Search Algorithm (CSA) and a Modified Cuckoo Search Algorithm (MCSA) for solving short-term hydrothermal scheduling (ST-HTS) problem. The CSA method is a new meta-heuristic algorithm inspired from the obligate brood parasitism of some cuckoo species by laying their eggs in the nests of other host birds of other species for solving optimization problems. In the MCSA method, the eggs are first classified into two groups in which ones with low fitness function are put in top group whereas others with higher fitness function are put in abandoned group. In addition, an updated step size in the MCSA changes and tends to decrease as the iteration increases leading to near global optimal solution. The robustness and effectiveness of the CSA and MCSA are tested on several systems with different objective functions of thermal units. The results obtained by the CSA and MCSA are analyzed and compared have shown that the two methods are favorable for solving short-term hydrothermal scheduling problems.

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Ali Sadollah, Korea University, South Korea

Joong Hoon Kim, Korea University, South Korea

In this chapter, a general strategy is recommended to solve variety of linear and nonlinear ordinary differential equations (ODEs) with boundary value conditions. With the aid of certain fundamental concepts of mathematics, Fourier series expansion, and metaheuristic algorithms, ODEs can be represented as an optimization problem. The purpose is to reduce the weighted residual error (error function) of the ODEs. Boundary values of ODEs are considered as constraints for the optimization model. Inverted generational distance metric is utilized for evaluation and assessment of approximate solutions versus exact solutions. Four ODEs having different orders and features are approximately solved and compared with their exact solutions. The optimization task is carried out using different optimizers including the particle swarm optimization and the water cycle algorithm. The optimization results obtained show that the proposed method equipped with metaheuristic algorithms can be successfully applied for approximate solving of different types of ODEs.

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Junzo Watada, Waseda University, Japan

Haydee Rocio Melo, Waseda University, Japan

Jaeseok Choi, Gyeongsang National University, South Korea

Recently, renewable power sources such as WTG and PV have become viable economic options for generating sustainable energy. However, WTG and PV have an inconstant power production problem. To solve this problem, multi-state models have been proposed. The electricity generated from these units varies with different time scales: hourly, daily and seasonally. Since planning an optimal size generates cost losses to the customer, three models should be built: a load model, generation model, and service cost model. Loss of energy expectation (LOEE) and loss of load expected (LOLE) are calculated for the load and generation model. The reliability value is calculated to determine the number of required renewable generators. As a result, the system is constructed to have sufficient capacity, and the utility cost became the main objective of the total service costs.

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Kawal Jeet, D. A. V. College, India

Renu Dhir, Dr. B. R. Ambedkar National Institute of Technology, India

Nature has always been a source of inspiration for human beings. Large numbers of complex optimization problems have been solved by the techniques inspired by nature. Software modularization is one of such complex problems that have been encountered by software engineers. It is the process of organizing modules of a software system into optimal clusters. In this chapter, some bio-inspired algorithms such as bat, artificial bee colony, black hole and firefly algorithm have been proposed for the cause of software modularization. The hybrid of these algorithms with crossover and mutation operators of the genetic algorithm has also been proposed. All the algorithms along with their hybrids are tested on seven benchmark open source software systems. It has been evaluated from the results thus obtained that the hybrid of these algorithms proved to optimize better than the existing genetic and hill-climbing approaches.

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Imran Rahman, Universiti Teknologi PETRONAS, Malaysia

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M. Abdullah-Al-Wadud, King Saud University, Saudi Arabia

Electrification of Transportation has undergone major modifications since the last decade. Success of combining smart grid technology and renewable energy exclusively depends upon the large-scale participation of Plug-in Hybrid Electric Vehicles (PHEVs) towards reach the desired pollution-free

transportation industry. One of the key Performance pointers of hybrid electric vehicle is the State-of-Charge (SoC) which needs to be enhanced for the advancement of charging station using computational intelligence methods. In this Chapter, authors applied Hybrid Particle swarm and gravitational search Optimization (PSOGSA) technique for intelligently allocating energy to the PHEVs considering constraints such as energy price, remaining battery capacity, and remaining charging time. Computational experiment results attained for maximizing the highly non-linear fitness function estimates the performance measure of both the techniques in terms of best fitness value and computation time.

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<i>I. Elamvazuthi, Universiti Teknologi Petronas, Malaysia</i>	
<i>P. Vasant, Universiti Teknologi Petronas, Malaysia</i>	

Multi objective (MO) optimization is an emerging field which is increasingly being implemented in many industries globally. In this work, the MO optimization of the extraction process of bioactive compounds from the Gardenia Jasminoides Ellis fruit was solved. Three swarm-based algorithms have been applied in conjunction with normal-boundary intersection (NBI) method to solve this MO problem. The gravitational search algorithm (GSA) and the particle swarm optimization (PSO) technique were implemented in this work. In addition, a novel Hopfield-enhanced particle swarm optimization was developed and applied to the extraction problem. By measuring the levels of dominance, the optimality of the approximate Pareto frontiers produced by all the algorithms were gauged and compared. Besides, by measuring the levels of convergence of the frontier, some understanding regarding the structure of the objective space in terms of its relation to the level of frontier dominance is uncovered. Detail comparative studies were conducted on all the algorithms employed and developed in this work.

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In the present chapter, we give an overview of iterative methods for linear complementarity problems (abbreviated as LCPs). We also introduce these iterative methods for the problems based on fixed-point

principle. Next, we present some new properties of preconditioned iterative methods for solving the LCPs. Convergence results of the sequence generated by these methods and also the comparison analysis between classic Gauss-Seidel method and preconditioned Gauss-Seidel (PGS) method for LCPs are established under certain conditions. Finally, the efficiency of these methods is demonstrated by numerical experiments. These results show that the mentioned models are effective in actual implementation and competitive with each other.

Chapter 22

Parameter Optimization of Photovoltaic Solar Cell and Panel Using Genetic Algorithms

Strategy 581

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In this chapter, we propose to perform a numerical technique based on genetic algorithms (GAs) to identify the electrical parameters (I_s , I_{ph} , R_s , R_{sh} , and n) of photovoltaic (PV) solar cells and modules. The one diode type approach is used to model the I–V characteristic of the solar cell. To extract electrical parameters, the approach is formulated as optimization problem. The GAs approach was used as a numerical technique in order to overcome problems involved in the local minima in the case optimization criteria. Compared to other methods, we find that the GAs is a very efficient technique to estimate the electrical parameters of photovoltaic solar cells and modules. Compared with other parameter extraction techniques, based on statistical study, results indicate the consistency and uniformity of method in terms of the quality of final solutions. In parallel, the simulated data with the extracted parameters of method base with GAs are in very good agreement with the experimental data in all cases.

Chapter 23

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Production and Maintenance Planning with Time Windows..... 601

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In this chapter, two approaches are developed to solve the integrated production planning and maintenance problem. Moreover, Some Propositions and mathematical properties were suggested and applied in the proposed heuristics to solve the problem. The first heuristic developed is based on Dantzig-Wolfe decomposition. The Dantzig-Wolfe Decomposition principle reformulates the original model and Column generation is then used to deal with the huge number of variables of the reformulated model. A simple rounding heuristic and a smoothing procedure are finally carried out in order to obtain integer solutions. The second heuristic is based on Lagrangean relaxation of the capacity constraints and sub-gradient optimization. At every step of sub-gradient method, feasibility and improvement procedures are applied to the solution of the Lagrangean problem. Computational experiments are carried out to show the results

obtained by our approaches and compared to those of commercial solver.

Chapter 24

TOPSIS in Generalized Intuitionistic Fuzzy Environment 630

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The aim of this chapter is to investigate the multiple attribute decision making problems to a selected project with generalized intuitionistic fuzzy information in which the information about weights is completely known and the attributes values are taken from the generalized intuitionistic fuzzy environment. Here, we extend the technique for order performance by similarity to ideal solution (TOPSIS) for the generalized intuitionistic fuzzy data. In addition, obtained the concept of possibility degree of generalized intuitionistic fuzzy numbers and used to solve ranking alternative in multi-attribute decision making problems.

Chapter 25

Bi-Criteria Optimization for Finding the Optimal Replacement Interval for Maintaining the Performance of the Process Industries 643

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The optimization of the maintenance decision making can be defined as an attempt to resolve the conflicts of decision situation in such a way that variable under the control of the decision maker take their best possible value. One of the most important controllable parameters is the time interval between maintenance. Most of the researchers have kept the fact that whenever the suitable maintenance interval is reached, the system is replaced with the original one. However the improvement of a system life not only depends on the replacement of deteriorated components, but also on the effectiveness of the maintenance. Taking care about this fact, the effects of maintenance of a multi-component system by combining the three main different PM actions, namely (1a), (1b) and (2p)-maintenance actions. Thus, the main purpose of an effective maintenance program is to present a technique for finding the optimal maintenance interval for the system by considering the multiple goals of the organization viz. maximum availability, minimum maintenance cost.

Chapter 26

Performances of Adaptive Cuckoo Search Algorithm in Engineering Optimization 676

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A new optimization algorithm, specifically, the cuckoo search algorithm (CSA), which inspired by the unique breeding strategy of cuckoos, has been developed recently. Preliminary studies demonstrated the comparative performances of the CSA as opposed to genetic algorithm and particle swarm optimization, however, with the competitive advantage of employing fewer control parameters. Given enough computation, the CSA is guaranteed to converge to the optimal solutions, albeit the search process associated to the random-walk behavior might be time-consuming. Moreover, the drawback from the fixed step size searching strategy in the inner computation of CSA still remain unsolved. The adaptive cuckoo search algorithm (ACSA), with the effort in the aspect of integrating an adaptive search strategy, was attached in this study. Its beneficial potential are analyzed in the benchmark test function optimization, as well as