Particle Swarm Optimization (PSO) is an algorithm modelled on swarm intelligence that finds a solution to an optimisation problem in a search space or model and predicts social behaviour in the presence of objectives. The PSO is a stochastic, population-based computer algorithm modelled on swarm intelligence. Swarm intelligence is based on social-psychological principles and provides insights into social behaviour, as well as contributing to engineering applications. This book presents information on particle swarm optimisation such as using mono-objective and multi-objective particle swarm optimisation for the tuning of process control laws; convergence issues in particle swarm optimisation; study on vehicle routing problems using enhanced particle swarm optimisation and others.

Critical Developments and Applications of Swarm Intelligence. In the era globalisation the emerging technologies are governing engineering industries to a multifaceted state. The escalating complexity has demanded researchers to find the possible ways of easing the solution of the problems. This has motivated the researchers to grasp ideas from the nature and implant it in the engineering sciences. This way of thinking led to emergence of many biologically inspired algorithms that have proven to be efficient in handling the computationally complex problems with competence such as Genetic Algorithm (GA), Ant Colony Optimisation (ACO), Particle Swarm Optimisation (PSO), etc. Motivated by the capability of the biologically inspired algorithms the present book on “Swarm Intelligence: Focus on Ant and Particle Swarm Optimisation” aims to present recent developments and applications concerning optimization with swarm intelligence techniques. The papers selected for this book comprise a cross-section of topics that reflect a variety of perspectives and disciplinary backgrounds. In addition to the introduction of new concepts of swarm intelligence, this book also presented some selected representative case studies covering power plant maintenance scheduling; geotechnical engineering; design and machining tolerances; layout problems; manufacturing process plan; job-shop scheduling; structural design; environmental dispatching problems; wireless communications; water distribution systems; multi-plant supply chain; fault diagnosis of airplane engines; and process scheduling. I believe these 27 chapters presented in this book adequately reflect these topics.

Swarm Intelligent Systems This book examines the bottom-up applicability of swarm intelligence to solving multiple problems, such as curve fitting, image segmentation, and swarm robotics. It compares the capabilities of some of the better-known bio-inspired optimization approaches, especially Particle Swarm Optimization (PSO), Darwinian Particle Swarm Optimization (DPSO) and the recently proposed Fractional Order Darwinian Particle Swarm Optimization (FODPSO), and comprehensively discusses their advantages and disadvantages. Further, it demonstrates the superiority and key advantages of using the FODPSO algorithm, such as its ability to provide an improved convergence towards a solution, while avoiding sub-optimality. This book offers a valuable resource for researchers in the fields of robotics, sports science, pattern recognition and machine learning, as well as for students of electrical engineering and computer science.

Swarm Intelligence Optimization This book presents the basic principles and current algorithms and methods of well-known swarm intelligence algorithms and efficient improvements from typical particle swarm optimisation (PSO), ant colony optimisation (ACO) and fireworks algorithm (FWA) as well as other swarm intelligence algorithms for swarm robotics.

Swarm Intelligence and Bio-Inspired Computation This volume examines the application of swarm intelligence in data mining, addressing the issues of swarm intelligence and data mining using novel intelligent approaches. The book comprises 11 chapters including an introduction reviewing fundamental definitions and important research challenges. Important features include a detailed overview of swarm intelligence and data mining paradigms, focused coverage of timely, advanced data mining topics, state-of-the-art theoretical research and application developments and contributions by pioneers in the field.

Fractional Order Darwinian Particle Swarm Optimization Swarm intelligence (SI) and bio-inspired computing in general have attracted great interest in almost every area of science, engineering, and industry over the last two decades. In this chapter, we provide an overview of some of the most widely used bio-inspired algorithms, especially those based on SI such as cuckoo search, firefly algorithm, and particle swarm optimization. We also analyze the essence of algorithms and their connections to self-organization. Furthermore, we highlight the main challenging issues associated with these metahuristic algorithms with in-depth discussions. Finally, we provide some key, open problems that need to be addressed in the next decade.

Swarm Intelligence Scheduling — evolutionary algorithms — particle swarm optimisation — swarm intelligence — real-time systems — small satellite.

Handbook of Research on Swarm Intelligence in Engineering Advanced inventory management in complex supply chains requires effective and robust nonlinear optimization due to the stochastic nature of supply and demand variations. Application of estimated gradients can boost up the convergence of Particle Swarm Optimization (PSO) algorithm but classical gradient calculation cannot be applied to stochastic and uncertain systems. In these situations Monte-Carlo (MC) simulation can be applied to determine the gradient. We developed a memory-based algorithm where
Swarm Intelligence and Bio-Inspired Computation Swarm Intelligence has recently emerged as a next-generation methodology belonging to the class of evolutionary computing. As a result, scientists have been able to explain and understand real-life processes and practices that previously remained unexplored. The Handbook of Research on Swarm Intelligence in Engineering presents the latest research being conducted on diverse topics in intelligence technologies such as Swarm Intelligence, Machine Intelligence, Optical Engineering, and Signal Processing with the goal of advancing knowledge and applications in this rapidly evolving field. The enriched interdisciplinary contents of this book will be a subject of interest to the widest forum of faculties, existing research communities, and new research aspirants from a multitude of disciplines and trades.

Swarm Intelligent Systems The purpose of this book is to collect contributions that are at the intersection of multi-objective optimization, swarm intelligence (specifically, particle swarm optimization and ant colony optimization) and data mining.

Swarm Intelligence and Bio-Inspired Computation The two-volume set (LNCs 6728 and 6729) constitutes the refereed proceedings of the International Conference on Swarm Intelligence, ICSI 2011, held in Chongqing, China, in June 2011. The 143 revised full papers presented were carefully reviewed and selected from 298 submissions. The papers are organized in topical sections on theoretical analysis of swarm intelligence algorithms, particle swarm optimization, applications of pso algorithms, ant colony optimization algorithms, bee colony algorithms, novel swarm-based optimization algorithms, artificial immune system, differential evolution, neural networks, genetic algorithms, evolutionary computation, fuzzy methods, and hybrid algorithms - for instance addressing such as multi-objective optimization algorithms, multi-robot, swarm-robot, and multi-agent systems, data mining methods, machine learning methods, feature selection algorithms, pattern recognition methods, intelligent control, other optimization algorithms and applications, data fusion and swarm intelligence, as well as fish school search - foundations and applications.

Recent Advances in Swarm Intelligence and Evolutionary Computation Artificial plant optimization algorithm (APOA) is a novel evolutionary strategy inspired by tree’s growing process. In this chapter, the methodologies of prototypical APOA and its updated version are illustrated. First, the primary framework is introduced by accounting for photosynthesis and phototropism phenomena. Since some important factors are ignored during mimicking branch’s growing, the optimization is sometimes misleading and time-consuming. Therefore, the standard version is developed by adding geotropism mechanism and apical dominance operator. The quality of the proposed technique is verified by two applications on artificial neural network training and toy model of protein folding. Simulation results are consistent with reported numerical data, indicating that the new optimization approach is valid and shows broad application in other fields.

Swarm Intelligence and Bio-Inspired Computation Swarm intelligence and bio-inspired computation have become increasing popular in the last two decades. Bio-inspired algorithms such as ant colony algorithms, bat algorithms, bee algorithms, firefly algorithms, cuckoo search and particle swarm optimization have been applied in almost every area of science and engineering with a dramatic increase of number of relevant publications. This book reviews the latest developments in swarm intelligence and bio-inspired computation from both the theory and application side, providing a complete resource that analyzes and discusses the latest and future trends in research directions. It can help new researchers to carry out timely research and inspire readers to develop new algorithms. With its impressive breadth and depth, this book will be useful for advanced undergraduate students, PhD students and lecturers in computer science, engineering and science as well as researchers and engineers. Focuses on the introduction and analysis of key algorithms Includes case studies for real-world applications Contains a balance of theory and applications, so readers who are interested in either algorithm or applications will all benefit from this timely book.

Handbook of Swarm Intelligence This book covers the latest in multi-objective swarm intelligence and cooperative behavior. It contains innovative and intriguing applications as well as additions to the methodology and theory of genetic programming.

Particle Swarm Optimization Artificial intelligence is a constantly advancing field that requires models in order to accurately create functional systems. The use of natural acumen to create artificial intelligence creates a field of research in which the natural and the artificial meet in a new and innovative way. Critical Developments and Applications of Swarm Intelligence is a critical academic publication that examines developing research, technologies, and function regarding natural and artificial acumen specifically, in regards to self-organized systems. Featuring coverage on a broad range of topics such as evolutionary algorithms, optimization techniques, and computational comparison, this book is geared toward academicians, students, researchers, and engineers seeking relevant and current research on the progressive research based on the implementation of swarm intelligence in self-organized systems.

Particle Swarm Optimization "This book presents the most recent and established developments of Particle swarm optimization (PSO) within a unified framework by noted researchers in the field" - Provided by publisher.

Swarm Intelligence This book and its companion volume, LNCs vols. 7928 and 7929 constitute the proceedings of the 4th International Conference on Swarm Intelligence, ICSI 2013, held in Harbin, China in June 2013. The 129 revised full papers presented were carefully reviewed and selected from 268 submissions. The papers are organized in 22 cohesive sections covering all major topics of swarm intelligence research and developments. The following topics are covered in this volume: Analysis of swarm intelligence based algorithms, particle swarm optimization, applications of particle swarm optimization algorithms, ant colony optimization algorithms, biogeography-based optimization algorithms, novel swarm-based search methods, bee colony algorithms, differential evolution, neural networks, fuzzy methods, evolutionary programming and evolutionary games.

Fundamentals of Computational Swarm Intelligence Swarm intelligence refers to collective intelligence. Biologists and natural scientist have been studying the behavior of social insects due to their efficiency of solving complex problems such as finding the shortest path between their nest and food source or organizing their nests. In spite of the fact that these insects are unsophisticated individually, they make wonders as a swarm by interaction with each other and their environment. In last two decades, the behaviors of various swarms that are used in finding preys or mating are studied, and hybrid algorithms - for instance addressing such as multi-objective optimization algorithms, multi-robot, swarm-robot, and multi-agent systems, data mining methods, machine learning methods, feature selection algorithms, pattern recognition methods, intelligent control, other optimization algorithms and applications, data fusion and swarm intelligence, as well as fish school search - foundations and applications.

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Particle Swarm Optimization (PSO) is a population-based stochastic optimization technique influenced by the social behavior of bird flocking or fish schooling. PSO shares many similarities with evolutionary computation techniques such as Genetic Algorithms (GA). The system is initialized with a population of random solutions and searches for optima by updating generations. However, unlike GA, PSO has no evolution operators such as crossover and mutation. In PSO, the potential solutions, called particles, fly through the problem space by following the current optimum particles. This book represents the contributions of the top researchers in this field and will serve as a valuable tool for professionals in this interdisciplinary field.

Swarm Intelligence and Bio-Inspired Computation The field of research that studies the emergent collective intelligence of self-organized and decentralized simple agents is referred to as Swarm Intelligence. It is based on social behavior that can be observed in nature, such as flocks of birds, fish schools and bee hives, where a number of individuals with limited capabilities are able to come to intelligent solutions for complex problems. The computer science community has already learned about the importance of emergent behaviors for complex problem solving. Hence, this book presents some recent advances on Swarm Intelligence, specially on new swarm-based optimization methods and hybrid algorithms for several applications. The content of this book allows the reader to know more both theoretical and technical aspects and applications of Swarm Intelligence.

Swarm Intelligence Resource optimization has always been a thrust area of research, and as the Internet of Things (IoT) is the most talked about topic of the current era of technology, it has become the need of the hour. Therefore, the idea behind this book was to simplify the journey of those who aspire to understand resource optimization in IoT. To this end, included in this book are various real-time/offline applications and algorithms/case studies in the field of engineering, computer science, information security, and cloud computing, along with the modern tools and various technologies used in systems, leaving the reader with a high level of understanding of various techniques and algorithms used in resource optimization.

Swarm Intelligence This timely review volume summarizes the state-of-the-art developments in nature-inspired algorithms and applications with the emphasis on swarm intelligence and bio-inspired computation. Topics include the analysis and overview of swarm intelligence and evolutionary computation, hybrid metaheuristic algorithms, bat algorithm, discrete cuckoo search, firefly algorithm, particle swarm optimization, and harmony search as well as convergent hybridization. Application case studies have focused on the dehydrogenation of fruits and vegetables by the firefly algorithm and goal programming, feature selection by the binary flower pollination algorithm, job shop scheduling, single row facility layout optimization, training of feed-forward neural networks, damage and stiffness identification, synthesis of cross-ambiguity functions by the bat algorithm, web document clustering, truss analysis, water distribution networks, sustainable building designs and others. As a timely review, this book can serve as an ideal reference for graduate students, lecturers, engineers and researchers in computer science, evolutionary computing, artificial intelligence, machine learning, computational intelligence, data mining, engineering optimization and designs.

Innovations in Swarm Intelligence The aim of this book is to understand the state-of-the-art theoretical and practical advances of swarm intelligence. It comprises seven contemporary relevant chapters. In chapter 1, a review of Bacteria Foraging Optimization (BFO) techniques for both single and multiple criteria problems is presented. A survey on swarm intelligence for multiple and many objectives optimization is presented in chapter 2 along with a topical study on EEG signal analysis. Without compromising the extensive simulation study, a comparative study of variants of MOPSO is included in chapter 3. Intractable practical problems like subset and job scheduling problems are discussed in chapters 4 and 7 by different hybrid swarm intelligence techniques. An attempt to study image enhancement by ant colony optimization is made in chapter 5. Finally, chapter 7 covers the aspect of uncertainty in data by hybrid PSO.

Swarm Intelligence and Bio-Inspired Computation The bi-volume set (LNCS 6728 and 6729) constitutes the refereed proceedings of the International Conference on Swarm Intelligence, ICSCI 2016, held in Bali, Indonesia, in June 2016. The 130 revised regular papers presented were carefully reviewed and selected from 231 submissions. The papers are organized in 22 cohesive sections covering major topics of swarm intelligence and related areas such as trend and models of several applications research; novel swarm-based optimization algorithms; swarming behavior; some swarm intelligence algorithms and their applications; hybrid search optimization; particle swarm optimization; PSO applications; ant colony optimization; brain storm optimization; fireworks algorithms; multi-objective optimization; large-scale global optimization; biometrics; scheduling and planning; machine learning methods; clustering algorithm; classification; image classification and encryption; data mining; sensor networks and social networks; neural networks; swarm intelligence in management decision making and operations research; robot control; swarm robotics; intelligent energy and communications systems; and intelligent and interactive and tutoring systems.

Multi-Objective Swarm Intelligent Systems Particle swarm optimization (PSO) is a population based stochastic optimization technique influenced by the social behavior of bird flocking or fish schooling. PSO shares many similarities with evolutionary computation techniques such as Genetic Algorithm (GA). The population of random solutions and searches for optimization by updating generations. However, unlike GA, PSO has no evolution operators such as crossover and mutation. In PSO, the potential solutions, called particles, fly through the problem space by following the current optimum particles. This book represents the contributions of the top researchers in this field and will serve as a valuable tool for professionals in this interdisciplinary field.

Advances in Swarm Intelligence Part I This two-volume set LNCS 9712 and LNCS 9713 constitutes the refereed proceedings of the 7th International Conference on Swarm Intelligence, ICSCI 2016, held in Bali, Indonesia, in June 2016. The 130 revised regular papers presented were carefully reviewed and selected from 231 submissions. The papers are organized in 22 cohesive sections covering major topics of swarm intelligence and related areas such as trend and models of several applications research; novel swarm-based optimization algorithms; swarming behavior; some swarm intelligence algorithms and their applications; hybrid search optimization; particle swarm optimization; PSO applications; ant colony optimization; brain storm optimization; fireworks algorithms; multi-objective optimization; large-scale global optimization; biometrics; scheduling and planning; machine learning methods; clustering algorithm; classification; image classification and encryption; data mining; sensor networks and social networks; neural networks; swarm intelligence in management decision making and operations research; robot control; swarm robotics; intelligent energy and communications systems; and intelligent and interactive and tutoring systems.

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Advances in Swarm Intelligence Part II The book contains chapters 2-13 and is organized into ten sections. These include: multi-objective optimization algorithms; multi-robot, swarm-robot, based optimization algorithms; artificial immune system; differential evolution; neural networks; genetic algorithms; evolutionary computation; fuzzy methods; and hybrid algorithms. The two volumes provide a comprehensive reference and source book for scientists, engineers, and researchers working in the fields of evolutionary computation and related areas, as well as for professionals involved in any area of application that utilizes swarm intelligence and bio-inspired computation. Topics include the analysis and overview of swarm intelligence and evolutionary computation, hybrid metaheuristic algorithms, bat algorithm, discrete cuckoo search, firefly algorithm, particle swarm optimization, and harmony search as well as convergent hybridization. Application case studies have focused on the dehydrogenation of fruits and vegetables by the firefly algorithm and goal programming, feature selection by the binary flower pollination algorithm, job shop scheduling, single row facility layout optimization, training of feed-forward neural networks, damage and stiffness identification, synthesis of cross-ambiguity functions by the bat algorithm, web document clustering, truss analysis, water distribution networks, sustainable building designs and others. As a timely review, this book can serve as an ideal reference for graduate students, lecturers, engineers and researchers in computer science, evolutionary computing, artificial intelligence, machine learning, computational intelligence, data mining, engineering optimization and designs.

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Particle Swarm Optimization and Intelligence Advances And Applications: From Nature, we observe swarming behavior in the form of ant colonies, bird flocking, animal herding, honey bees, swarming of bacteria, and many more. It is only in recent years that researchers have taken notice of such natural swarming systems as a form of some form of innate collective intelligence, albeit swarm intelligence (SI) - a metaphor that inspires a myriad of computational problem-solving techniques. In computational intelligence, swarm-like algorithms have been successfully applied to solve many real-world problems in engineering and sciences. This handbook volume serves as a useful foundational text as well as a source of state-of-the-art contributions to the field from various authors around the globe. It has a rich collection of contributions that provides a good representation of the theoretical and empirical study of single and multi-objective variants of swarm intelligence based algorithms like particle swarm optimization (PSO), ant colony optimization (ACO), bacterial foraging optimization algorithm (BFOA), honey bee social foraging algorithms, and harmony search (HS). With chapters describing various applications of SI techniques in real-world engineering problems, this handbook can be a valuable resource for researchers and practitioners, giving an in-depth flavor of what SI is capable of achieving.

Advances in Swarm Intelligence, Part II Over the past two decades, swarm intelligence has emerged as a powerful approach to solving optimization as well as other complex problems. Swarm intelligence models are inspired by social behaviors of simple agents interacting among themselves as well as with the environment, e.g., flocking of birds, schooling of fish, foraging of bees and ants. The collective behaviors that emerge out of the interactions at the colony level are useful in achieving complex goals. The main aim of this research book is to present a sample of the exciting innovations and advances in techniques and applications of swarm intelligence. Among the topics covered in this book include: particle swarm optimization and hybrid methods, ant colony optimization and hybrid methods, bee colony optimization, glowworm swarm optimization, and complex social swarms, application of various swarm intelligence models to operational planning of energy plants, modeling and control of nanorobots, classification of documents, identification of disease biomarkers, and prediction of gene signals. The book is directed to researchers, practicing professionals, and undergraduate as well as graduate students of all disciplines who are interested in enhancing their knowledge in techniques and applications of swarm intelligence.

Preface: Swarm Intelligence, Focus on Ant and Particle Swarm Optimization Random walks play an important and central role in metaheuristic and stochastic optimization algorithms. The two key components of the search process in metaheuristic algorithms (MAs) are intensification and diversification. The overall efficiency of a metaheuristic optimization algorithm depends on a sound balance between these two components. In MAs, exploration is achieved by randomization in combination with a deterministic procedure. In this way, the newly generated solutions are distributed as diversely as possible in the problem search space. In most of the MAs, randomization is realized using a uniform or Gaussian distribution. However, this is not the only way to achieve randomization. In recent years, the use of Lévy flights has emerged as an alternative to uniform or Gaussian distributions. In view of these details, this chapter focuses on using Lévy flights (LFs) in the context of global optimization. A survey of the most important MAs using LFs to achieve intensification and diversification for solving global optimization problems is presented. The different components and concepts of Lévy flight-based MAs are discussed and their similarities and differences are analyzed.

Multi-objective Swarm Intelligence

Advances in Swarm Intelligence Fundamentals of Computational Swarm Intelligence provides a comprehensive introduction to the new computational paradigm of Swarm Intelligence (SI), a field that emerged from biological research, and is now picking up momentum within the computational research community. Bio-inspired systems are becoming increasingly important research areas for computer scientists, engineers, economists, bioinformaticians, operational researchers, and many other disciplines. This book introduces the reader to the mathematical models of social insects collective behavior, and shows how they can be used in solving optimization problems. Focusing on the algorithmic implementation of models of swarm behavior, this book: Examines how social network structures are used to exchange information among individuals, and how the aggregated behavior of these individuals forms a powerful organism. Introduces a compact summary of the formal theory of optimization. Outlines paradigms with relations to SI, including genetic algorithms, evolutionary programming, evolutionary strategies, cultural algorithms and co-evolution. Looks at the catastrophic movements of birds in a flock as a basis for the Particle Swarm Optimization (PSO) models, and provides an extensive treatment of different classes of PSO models. Shows how the behavior of ants can be used to implement Ant Colony Optimization (ACO) algorithms to solve real-world problems including routing optimization, structure optimization, data mining and data clustering. Considers different clustering problems, including multi-objective optimization, dynamic environments, discrete and continuous search spaces, constrained optimization, and niching. Includes an accompanying website containing a collection of implementations of the different algorithms that can be used to test PSO and ACO algorithms: http://isi.cs.up.ac.za The interdisciplinary nature of this field will make Fundamentals of Computational Swarm Intelligence an essential resource for readers with diverse backgrounds. In addition, it will be an excellent reference for computer scientists, practitioners in business or industry and researchers involved in the analysis, design and simulation of multibody systems. Advanced undergraduates and graduate students in artificial intelligence, collective intelligence and engineering will also find this book an invaluable tool.

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Emerging Research on Swarm Intelligence and Algorithm Optimization Systems designers have learned that many agents co-operating within the system can solve very complex problems with a minimal design effort. In general, multi-agent systems that use swarm intelligence are said to be swarm intelligent systems. Today, these are mostly used as search engines and optimization tools. This volume reviews innovative methodologies of swarm intelligence, outlines the foundations of engineering swarm intelligent systems and applications, and relates experiences using the particle swarm optimisation.

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