



# Swarm Intelligence

**About Ella Hassanien, Eid Emary**



## **Swarm Intelligence:**

Swarm Intelligence Felix Chan, Manoj Tiwari, 2007-12-01 In the era of 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 the 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 Optimization, ACO, Particle Swarm Optimization, PSO, etc. Motivated by the capability of the biologically inspired algorithms, the present book on Swarm Intelligence: Focus on Ant and Particle Swarm Optimization 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 presents 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 communication, 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 Intelligence Kuldeep Singh Kaswan, Jagjit Singh Dhattewal, Avadhesh Kumar, 2023-03-14 SWARM INTELLIGENCE This important authored book presents valuable new insights by exploring the boundaries shared by cognitive science, social psychology, artificial life, artificial intelligence, and evolutionary computation by applying these insights to solving complex engineering problems. Motivated by the capability of the biologically inspired algorithms, Swarm Intelligence: An Approach from Natural to Artificial focuses on ant, cat, crow, elephant, grasshopper, water wave, and whale optimization, swarm cyborg, and particle swarm optimization and presents recent developments and applications concerning optimization with swarm intelligence techniques. The goal of the book is to offer a wide spectrum of sample works developed in leading research throughout the world about innovative methodologies of swarm intelligence and foundations of engineering swarm intelligent systems, as well as applications and interesting experiences using particle swarm optimization, which is at the heart of computational intelligence. Discussed in the book are applications of various swarm intelligence models to operational planning of energy plants, modeling and control of robots, organic computing, techniques of cloud services, bio-inspired optimization, routing protocols for next-generation networks inspired by collective behaviors of insect societies and cybernetic organisms. Audience: The book is directed to researchers, practicing engineers, and students in computational intelligence who are interested in enhancing their knowledge of techniques and swarm intelligence.

**Swarm Intelligence Algorithms (Two Volume Set)** Adam Slowik, 2021-01-26 Swarm intelligence algorithms are a form of nature-based optimization algorithms. Their main

inspiration is the cooperative behavior of animals within specific communities This can be described as simple behaviors of individuals along with the mechanisms for sharing knowledge between them resulting in the complex behavior of the entire community Examples of such behavior can be found in ant colonies bee swarms schools of fish or bird flocks Swarm intelligence algorithms are used to solve difficult optimization problems for which there are no exact solving methods or the use of such methods is impossible e g due to unacceptable computational time This set comprises two volumes Swarm Intelligence Algorithms A Tutorial and Swarm Intelligence Algorithms Modifications and Applications The first volume thoroughly presents the basics of 24 algorithms selected from the entire family of swarm intelligence algorithms It contains a detailed explanation of how each algorithm works along with relevant program codes in Matlab and the C programming language as well as numerical examples illustrating step by step how individual algorithms work The second volume describes selected modifications of these algorithms and presents their practical applications This book presents 24 swarm algorithms together with their modifications and practical applications Each chapter is devoted to one algorithm It contains a short description along with a pseudo code showing the various stages of its operation In addition each chapter contains a description of selected modifications of the algorithm and shows how it can be used to solve a selected practical problem

**Swarm Intelligence Algorithms** Adam Slowik,2020-08-25 Nature based algorithms play an important role among artificial intelligence algorithms Among them are global optimization algorithms called swarm intelligence algorithms These algorithms that use the behavior of simple agents and various ways of cooperation between them are used to solve specific problems that are defined by the so called objective function Swarm intelligence algorithms are inspired by the social behavior of various animal species e g ant colonies bird flocks bee swarms schools of fish etc The family of these algorithms is very large and additionally includes various types of modifications to enable swarm intelligence algorithms to solve problems dealing with areas other than those for which they were originally developed This book presents 24 swarm algorithms together with their modifications and practical applications Each chapter is devoted to one algorithm It contains a short description along with a pseudo code showing the various stages of its operation In addition each chapter contains a description of selected modifications of the algorithm and shows how it can be used to solve a selected practical problem This book should also be useful for undergraduate and postgraduate students studying nature based optimization algorithms and can be a helpful tool for learning these algorithms along with their modifications and practical applications In addition it can be a useful source of knowledge for scientists working in the field of artificial intelligence as well as for engineers interested in using this type of algorithms in their work If the reader wishes to expand his knowledge beyond the basics of swarm intelligence algorithms presented in this book and is interested in more detailed information we recommend the book Swarm Intelligence Algorithms A Tutorial Edited by A Slowik CRC Press 2020 It contains a detailed explanation of how each algorithm works along with relevant program codes in Matlab and the C programming language as well as numerical

examples illustrating step by step how individual algorithms work      *Swarm Intelligence* Eric Bonabeau, Marco Dorigo, Guy Theraulaz, 1999-10-21 In particular these designs are an exciting approach to the tremendous growth of complexity in software and information Swarm Intelligence draws on up to date research from biology neuroscience artificial intelligence robotics operations research and computer graphics and each chapter is organized around a particular biological example which is then used to develop an algorithm a multiagent system or a group of robots      **Swarm Intelligence** Andrew Schumann, 2020-11-03 The notion of swarm intelligence was introduced for describing decentralized and self organized behaviors of groups of animals Then this idea was extrapolated to design groups of robots which interact locally to cumulate a collective reaction Some natural examples of swarms are as follows ant colonies bee colonies fish schooling bird flocking horse herding bacterial colonies multinucleated giant amoebae *Physarum polycephalum* etc In all these examples individual agents behave locally with an emergence of their common effect An intelligent behavior of swarm individuals is explained by the following biological reactions to attractants and repellents Attractants are biologically active things such as food pieces or sex pheromones which attract individuals of swarm Repellents are biologically active things such as predators which repel individuals of swarm As a consequence attractants and repellents stimulate the directed movement of swarms towards and away from the stimulus respectively It is worth noting that a group of people such as pedestrians follow some swarm patterns of flocking or schooling For instance humans prefer to avoid a person considered by them as a possible predator and if a substantial part of the group in the situation of escape panic not less than 5% changes the direction then the rest follows the new direction too Some swarm patterns are observed among human beings under the conditions of their addictive behavior such as the behavior of alcoholics or gamers The methodological framework of studying swarm intelligence is represented by unconventional computing robotics and cognitive science In this book we aim to analyze new methodologies involved in studying swarm intelligence We are going to bring together computer scientists and cognitive scientists dealing with swarm patterns from social bacteria to human beings This book considers different models of simulating controlling and predicting the swarm behavior of different species from social bacteria to humans      **Handbook of Swarm Intelligence** Bijaya Ketan Panigrahi, Yuhui Shi, Meng-Hiot Lim, 2011-02-04 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 culmination 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 as well as consolidatory state of art collection of articles in the field from various researchers around the globe It has a rich collection of contributions pertaining to 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

**Swarm Intelligence** Christian Blum, Daniel Merkle, 2008-09-24 Swarm intelligence is a modern artificial intelligence discipline that is concerned with the design of multiagent systems with applications e.g. in optimization and in robotics The design paradigm for these systems is fundamentally different from more traditional approaches Instead of a sophisticated controller that governs the global behavior of the system the swarm intelligence principle is based on many unsophisticated entities that cooperate in order to exhibit a desired behavior Inspiration for the design of these systems is taken from the collective behavior of social insects such as ants termites bees and wasps as well as from the behavior of other animals societies such as flocks of birds or schools of fish Colonies of social insects have mesmerized researchers for many years However the principles that govern their behavior remained unknown for a long time Even though the single members of these societies are unsophisticated individuals they are able to achieve complex tasks in cooperation Coordinated behavior emerges from relatively simple actions or interactions between the individuals

**Swarm Intelligence** Abhishek Sharma, Abhinav Sharma, Jitendra Kumar Pandey, Mangey Ram, 2022-02-01 Swarm intelligence is one of the fastest growing subfields of artificial intelligence and soft computing This field includes multiple optimization algorithms to solve NP hard problems for which conventional methods are not effective It inspires researchers in engineering sciences to learn theories from nature and incorporate them Swarm Intelligence Foundation Principles and Engineering Applications provides a comprehensive review of new swarm intelligence techniques and offers practical implementation of Particle Swarm Optimization PSO with MATLAB code The book discusses the statistical analysis of swarm optimization techniques so that researchers can analyze their experiment design It also includes algorithms in social sectors oil and gas industries and recent research findings of new optimization algorithms in the field of engineering describing the implementation in machine learning This book is written for students of engineering research scientists and academicians involved in the engineering sciences

**Swarm Intelligence** Aboul Ella Hassanien, Eid Emary, 2018-09-03 Swarm Intelligence Principles Advances and Applications delivers in depth coverage of bat artificial fish swarm firefly cuckoo search flower pollination artificial bee colony wolf search and gray wolf optimization algorithms The book begins with a brief introduction to mathematical optimization addressing basic concepts related to swarm intelligence such as randomness random walks and chaos theory The text then Describes the various swarm intelligence optimization methods standardizing the variants hybridizations and algorithms whenever possible Discusses variants that focus more on binary discrete constrained adaptive and chaotic versions of the swarm optimizers Depicts real world applications of the individual optimizers emphasizing variable selection and fitness function design Details the similarities differences weaknesses and strengths of each swarm optimization method Draws parallels between the

operators and searching manners of the different algorithms

*Swarm Intelligence Principles Advances and Applications* presents a comprehensive treatment of modern swarm intelligence optimization methods complete with illustrative examples and an extendable MATLAB package for feature selection in wrapper mode applied on different data sets with benchmarking using different evaluation criteria The book provides beginners with a solid foundation of swarm intelligence fundamentals and offers experts valuable insight into new directions and hybridizations

*Swarm Intelligence* Ying Tan, 2018-10-05

Swarm Intelligence SI is one of the most important and challenging paradigms under the umbrella of computational intelligence It focuses on the research of collective behaviours of a swarm in nature and or social phenomenon to solve complicated and difficult problems which cannot be handled by traditional approaches Thousands of papers are published each year presenting new algorithms new improvements and numerous real world applications This makes it hard for researchers and students to share their ideas with other colleagues follow up the works from other researchers with common interests and to follow new developments and innovative approaches This complete and timely collection fills this gap by presenting the latest research systematically and thoroughly to provide readers with a full view of the field of swarm

Students will learn the principles and theories of typical swarm intelligence algorithms scholars will be inspired with promising research directions and practitioners will find suitable methods for their applications of interest along with useful instructions

**Swarm Intelligence Algorithms** Adam Slowik, 2020-08-25

Swarm intelligence algorithms are a form of nature based optimization algorithms Their main inspiration is the cooperative behavior of animals within specific communities This can be described as simple behaviors of individuals along with the mechanisms for sharing knowledge between them resulting in the complex behavior of the entire community Examples of such behavior can be found in ant colonies bee swarms schools of fish or bird flocks

Swarm intelligence algorithms are used to solve difficult optimization problems for which there are no exact solving methods or the use of such methods is impossible e g due to unacceptable computational time This book thoroughly presents the basics of 24 algorithms selected from the entire family of swarm intelligence algorithms Each chapter deals with a different algorithm describing it in detail and showing how it works in the form of a pseudo code In addition the source code is provided for each algorithm in Matlab and in the C programming language In order to better understand how each swarm intelligence algorithm works a simple numerical example is included in each chapter which guides the reader step by step through the individual stages of the algorithm showing all necessary calculations This book can provide the basics for understanding how swarm intelligence algorithms work and aid readers in programming these algorithms on their own to solve various computational problems This book should also be useful for undergraduate and postgraduate students studying nature based optimization algorithms and can be a helpful tool for learning the basics of these algorithms efficiently and quickly In addition it can be a useful source of knowledge for scientists working in the field of artificial intelligence as well as for engineers interested in using this type of algorithms in their work If

the reader already has basic knowledge of swarm intelligence algorithms we recommend the book *Swarm Intelligence Algorithms Modifications and Applications* Edited by A Slowik CRC Press 2020 which describes selected modifications of these algorithms and presents their practical applications

*Energy Optimization Protocol Design for Sensor Networks in IoT Domains* Sanjeev J. Wagh, Manisha Sunil Bhende, Anuradha D. Thakare, 2022-10-07 This book provides an essential overview of IoT energy efficient topology control protocols motivation and challenges for topology control for Wireless Sensor Networks and the scope of the research in the domain of IoT Further it discusses the different design issues of topology control and energy models for IoT applications different types of simulators with their advantages and disadvantages It also discusses extensive simulation results and comparative analysis for various algorithms The key point of this book is to present a solution to minimize energy and extend the lifetime of IoT networks using optimization methods to improve the performance Features Describes various facets necessary for energy optimization in IoT domain Covers all aspects to achieve energy optimization using latest technologies and algorithms in wireless sensor networks Presents various IoT and Topology Control Methods and protocols various network models and model simulation using MATLAB Reviews methods and results of optimization with Simulation Hardware architecture leading to prolonged life of IoT networks First time introduces bio inspired algorithms in the IoT domain for performance optimization This book aims at Graduate Students Researchers in Information Technology Computer Science and Engineering Electronics and Communication Engineering

[A Primer on Multiple Intelligences](#) Matthew N. O. Sadiku, Sarhan M. Musa, 2021-07-24 This book provides an introduction to nineteen popular multiple intelligences Part One discusses general intelligence psychological testing naturalistic intelligence social intelligence emotional intelligence interpersonal intelligence and cultural intelligence Part Two tackles machine intelligence the development of artificial intelligence computational intelligence and digital intelligence or the ability for humans to adapt to a digital environment Finally Part Three discusses the role of intelligence in business development using technology to augment intelligence abstract thinking swarm and animal intelligence military intelligence and musical intelligence A Primer on Multiple Intelligences is a must read for graduate students or scholars considering researching cognition perception motivation and artificial intelligence It will also be of use to those in social psychology computer science and pedagogy It is as a valuable resource for anyone interested in learning more about the multifaceted study of intelligence

**Nature-Inspired Intelligent Techniques for Solving Biomedical Engineering Problems** Kose, Utku, Guraksin, Gur Emre, Deperlioglu, Omer, 2018-03-31 Technological tools and computational techniques have enhanced the healthcare industry These advancements have led to significant progress and novel opportunities for biomedical engineering Nature Inspired Intelligent Techniques for Solving Biomedical Engineering Problems is a pivotal reference source for emerging scholarly research on trends and techniques in the utilization of nature inspired approaches in biomedical engineering Featuring extensive coverage on relevant areas such as artificial intelligence clinical decision support systems and swarm

intelligence this publication is an ideal resource for medical practitioners professionals students engineers and researchers interested in the latest developments in biomedical technologies *Fog, Edge, and Pervasive Computing in Intelligent IoT Driven Applications* Deepak Gupta, Aditya Khamparia, 2021-01-07 A practical guide to the design implementation evaluation and deployment of emerging technologies for intelligent IoT applications With the rapid development in artificially intelligent and hybrid technologies IoT edge fog driven and pervasive computing techniques are becoming important parts of our daily lives This book focuses on recent advances roles and benefits of these technologies describing the latest intelligent systems from a practical point of view Fog Edge and Pervasive Computing in Intelligent IoT Driven Applications is also valuable for engineers and professionals trying to solve practical economic or technical problems With a uniquely practical approach spanning multiple fields of interest contributors cover theory applications and design methodologies for intelligent systems These technologies are rapidly transforming engineering industry and agriculture by enabling real time processing of data via computational resource oriented metaheuristics and machine learning algorithms As edge fog computing and associated technologies are implemented far and wide we are now able to solve previously intractable problems With chapters contributed by experts in the field this book Describes Machine Learning frameworks and algorithms for edge fog and pervasive computing Considers probabilistic storage systems and proven optimization techniques for intelligent IoT Covers 5G edge network slicing and virtual network systems that utilize new networking capacity Explores resource provisioning and bandwidth allocation for edge fog and pervasive mobile applications Presents emerging applications of intelligent IoT including smart farming factory automation marketing automation medical diagnosis and more Researchers graduate students and practitioners working in the intelligent systems domain will appreciate this book s practical orientation and comprehensive coverage Intelligent IoT is revolutionizing every industry and field today and Fog Edge and Pervasive Computing in Intelligent IoT Driven Applications provides the background orientation and inspiration needed to begin

*Swarm Intelligence* , 2019-12-04 Swarm Intelligence has emerged as one of the most studied artificial intelligence branches during the last decade constituting the fastest growing stream in the bio inspired computation community A clear trend can be deduced analyzing some of the most renowned scientific databases available showing that the interest aroused by this branch has increased at a notable pace in the last years This book describes the prominent theories and recent developments of Swarm Intelligence methods and their application in all fields covered by engineering This book unleashes a great opportunity for researchers lecturers and practitioners interested in Swarm Intelligence optimization problems and artificial intelligence **Python Machine Learning** Ryan Turner, 2020-04-18 Are you a novice programmer who wants to learn Python Machine Learning Are you worried about how to translate what you already know into Python This book will help you overcome those problems As machines get ever more complex and perform more and more tasks to free up our time so it is that new ideas are developed to help us continually improve their speed and abilities One of these is Python and in

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**Swarm Intelligence** Wellington Pinheiro dos Santos,Juliana Carneiro Gomes,Valter Augusto de Freitas Barbosa,2022-11-17 This book presents the fundamentals of swarm intelligence from classic algorithms to emerging techniques It presents comprehensive theoretical foundations and examples using the main Computational Intelligence methods in programming languages such as Python Java and MATLAB Real world applications are also presented in areas as diverse as Medicine Biology and industrial applications The book is organized into two parts The first part provides an introduction to swarming algorithms and hybrid techniques In the second part real world applications of swarm intelligence are presented to illustrate how swarm algorithms can be used in applications of optimization and pattern recognition

reviewing the principal methods and methodologies in swarm intelligence

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