

FIGURE 6. *Constance distribution*

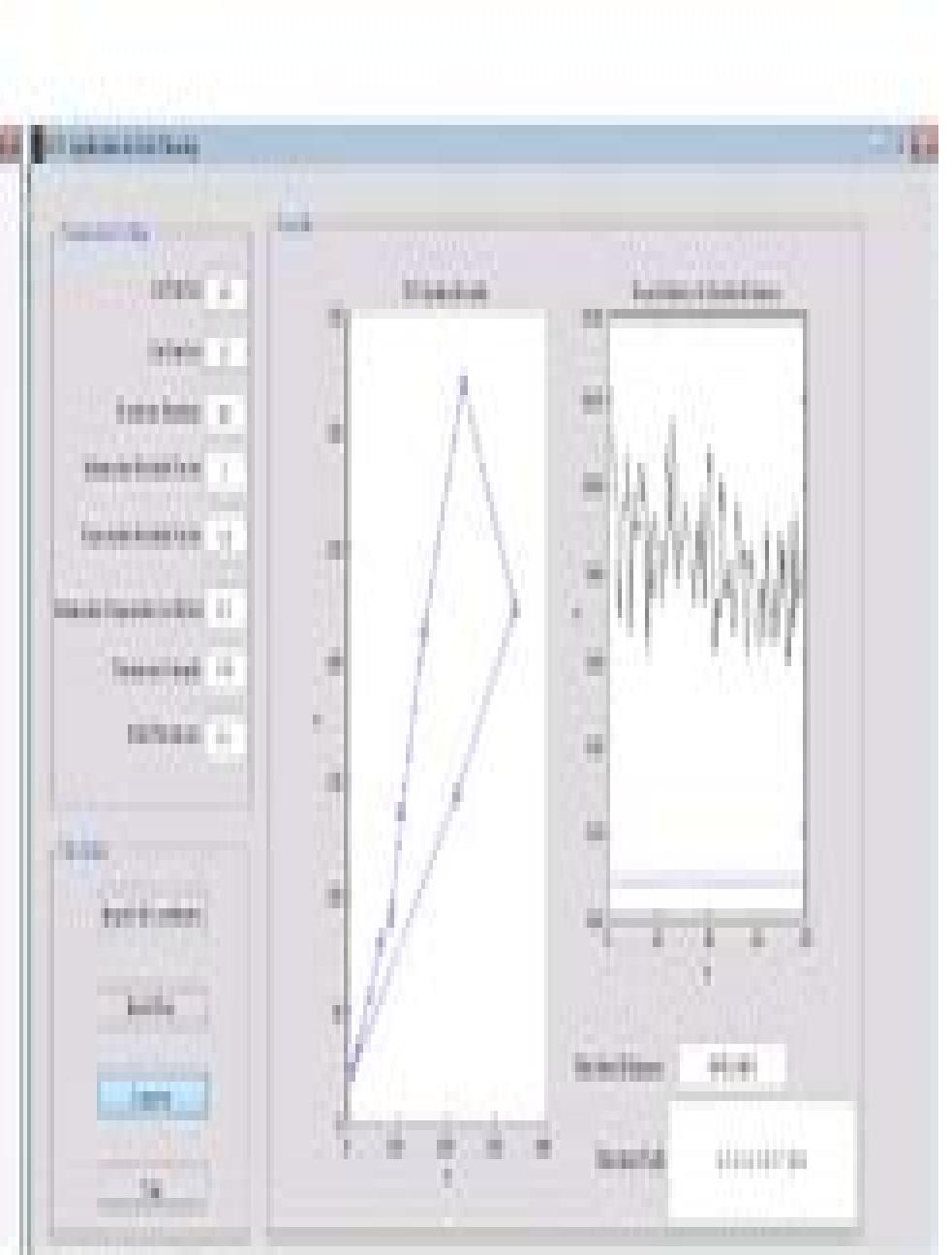


FIGURE 7. *Constance distribution*

# Ant Colony Optimization In Matlab Source Code

**Avi Ostfeld**

## **Ant Colony Optimization In Matlab Source Code:**

**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

**Evolutionary Multi-Criterion Optimization** Shigeru Obayashi,2007-02-12 This book constitutes the refereed proceedings of the 4th International Conference on Evolutionary Multi Criterion Optimization EMO 2007 held in Matsushima Japan in March 2007 The 65 revised full papers presented together with 4 invited papers are organized in topical sections on algorithm design algorithm improvements alternative methods applications engineering design many objectives objective handling and performance assessments

**Intelligent and Fuzzy Systems** Cengiz Kahraman,A. Cagri Tolga,Sezi Cevik Onar,Selcuk Cebi,Basar Oztaysi,Irem Ucal Sari,2022-07-04 This book presents recent research in intelligent and fuzzy techniques on digital transformation and the new normal the state to which economies societies etc settle following a crisis bringing us to a new environment Digital transformation and the new normal appearing in many areas such as digital economy digital finance digital government digital health and digital education are the main scope of this book The readers can benefit from this book for preparing for a digital new normal and maintaining a leadership position among competitors in both manufacturing and service companies Digitizing an industrial company is a challenging process which involves

rethinking established structures processes and steering mechanisms presented in this book The intended readers are intelligent and fuzzy systems researchers lecturers M Sc and Ph D students studying digital transformation and new normal The book covers fuzzy logic theory and applications heuristics and metaheuristics from optimization to machine learning from quality management to risk management making the book an excellent source for researchers

**11th**

**Mediterranean Conference on Medical and Biological Engineering and Computing 2007** Tomaz Jarm,Peter Kramar,Anze Zupanic,2007-10-24 Biomedical engineering today is a well recognized area of research It brings together bright minds from diverse disciplines ranging from engineering physics and computer sciences on one side to biology and medicine on the other side With valuable assistance of members of the International Advisory Committee and Scientific Program Committee the co organizing institutions and societies our sponsors and distinguished invited lecturers we will ensure that the research and development presented at MEDICON 2007 plenary meetings scientific sessions and workshops will truly be relevant and up to date The MEDICON conferences are international events of high scientific standards with long lasting tradition held every third year in one of the Mediterranean countries under the auspices of the International Federation for Medical and Biological Engineering

**Nanoelectronic Mixed-Signal System Design** Saraju

Mohanty,2015-02-20 Covering both the classical and emerging nanoelectronic technologies being used in mixed signal design this book addresses digital analog and memory components Winner of the Association of American Publishers 2016 PROSE Award in the Textbook Physical Sciences Mathematics category Nanoelectronic Mixed Signal System Design offers professionals and students a unified perspective on the science engineering and technology behind nanoelectronics system design Written by the director of the NanoSystem Design Laboratory at the University of North Texas this comprehensive guide provides a large scale picture of the design and manufacturing aspects of nanoelectronic based systems It features dual coverage of mixed signal circuit and system design rather than just digital or analog only Key topics such as process variations power dissipation and security aspects of electronic system design are discussed Top down analysis of all stages from design to manufacturing Coverage of current and developing nanoelectronic technologies not just nano CMOS Describes the basics of nanoelectronic technology and the structure of popular electronic systems Reveals the techniques required for design excellence and manufacturability

**Data Sources**

[Ant Colony Optimization](#)

Avi Ostfeld,2011-02-04 Ants communicate information by leaving pheromone tracks A moving ant leaves in varying quantities some pheromone on the ground to mark its way While an isolated ant moves essentially at random an ant encountering a previously laid trail is able to detect it and decide with high probability to follow it thus reinforcing the track with its own pheromone The collective behavior that emerges is thus a positive feedback where the more the ants following a track the more attractive that track becomes for being followed thus the probability with which an ant chooses a path increases with the number of ants that previously chose the same path This elementary ant s behavior inspired the development of ant

colony optimization by Marco Dorigo in 1992 constructing a meta heuristic stochastic combinatorial computational methodology belonging to a family of related meta heuristic methods such as simulated annealing Tabu search and genetic algorithms This book covers in twenty chapters state of the art methods and applications of utilizing ant colony optimization algorithms New methods and theory such as multi colony ant algorithm based upon a new pheromone arithmetic crossover and a repulsive operator new findings on ant colony convergence and a diversity of engineering and science applications from transportation water resources electrical and computer science disciplines are presented

### **Ant Colony**

**Optimization** Helio Barbosa,2013-02-20 Ant Colony Optimization ACO is the best example of how studies aimed at understanding and modeling the behavior of ants and other social insects can provide inspiration for the development of computational algorithms for the solution of difficult mathematical problems Introduced by Marco Dorigo in his PhD thesis 1992 and initially applied to the travelling salesman problem the ACO field has experienced a tremendous growth standing today as an important nature inspired stochastic metaheuristic for hard optimization problems This book presents state of the art ACO methods and is divided into two parts I Techniques which includes parallel implementations and II Applications where recent contributions of ACO to diverse fields such as traffic congestion and control structural optimization manufacturing and genomics are presented

*Ant Colony Optimization and Swarm Intelligence* Marco Dorigo,Mauro Birattari,Christian Blum,Luca M. Gambardella,Francesco Mondada,Thomas Stützle,2004-11-24 1 With its fourth edition the ANTS series of workshops has changed its name The originalANTS From Ant Colonies to Artificial Ants International Workshop on Ant Algorithms has become ANTS International Workshop on Ant Colony Optimization and Swarm Intelligence This change is mainly due to the following reasons First the term ant algorithms was slower in spreading in the research community than the term swarm intelligence while at the same time research inso called swarm robotics was the subject of increasing activity it was therefore an obvious choice to substitute the term ant algorithms with the more accepted and used term swarm intelligence Second although swarm intelligence research has undoubtedly produced a 2 number of interesting and promising research directions we think it is fair to say that its most successful strand is the one known as ant colony optimization Ant colony optimization first introduced in the early 1990s as a novel tool for the approximate solution of discrete optimization problems has recently seen an explosion in the number of its applications both to academic and real world problems and is currently being extended to the realm of continuous optimization a few papers on this subject being published in these proceedings It is therefore a reasonable choice to have the term ant colony optimization as part of the workshop name

*Ant Colony Optimization* Marco Dorigo,2002 **Theoretical and Practical Aspects of Ant Colony Optimization** Christian Blum,2004 Combinatorial optimization problems are of high academical and practical importance Unfortunately many of them belong to the class of NP hard problems and are therefore intractable In other words as their dimension increases the time needed by exact methods to find an optimal solution grows exponentially Metaheuristics are

approximate methods for attacking these problems An approximate method is a technique that is applied in order to find a good enough solution in a reasonable amount of time Examples of metaheuristics are simulated annealing tabu search evolutionary computation and ant colony optimization ACO the subject of this book The contributions of this book to ACO research are twofold First some new theoretical results are proven that improve our understanding of how ACO works Second a new framework for ACO algorithms is proposed that is shown to perform at the state of the art level on some important combinatorial optimization problems such as the k cardinality tree problem and the group shop scheduling problem which is a general shop scheduling problem that includes among others the well known job shop scheduling and the open shop scheduling problems

**Industrial PID Controller Tuning** José David Rojas,Orlando Arrieta,Ramon

Vilanova,2021-05-22 Industrial PID Controller Tuning presents a different view of the servo regulator compromise that has been studied for a long time in industrial control research Optimal tuning generally involves comparison of cost functions e g a quadratic function of the error or a time weighted absolute value of the error but without taking advantage of available multi objective optimization methods The book does make use of multi objective optimization to account for several sources of disturbance applying them to a more realistic problem how to select the tuning of a controller when both servo and regulator responses are important The authors review the different deterministic multi objective optimization methods In order to ameliorate the consequences of the computational expense typically involved in their use specifically the generation of multiple solutions among which the control engineer still has to choose algorithms for two degree of freedom PID control are implemented in MATLAB MATLAB code and a MATLAB compatible program are provided for download and will help readers to adapt the ideas presented in the text for use in their own systems Further practical guidance is offered by the inclusion of several examples of common industrial processes amenable to the use of the authors methods Researchers interested in non heuristic approaches to controller tuning or in decision making after a Pareto set has been established and graduate students interested in beginning a career working with PID control and or industrial controller tuning will find this book a valuable reference and source of ideas Advances in Industrial Control reports and encourages the transfer of technology in control engineering The rapid development of control technology has an impact on all areas of the control discipline The series offers an opportunity for researchers to present an extended exposition of new work in all aspects of industrial control

**Ant Colony Optimization and Swarm Intelligence** Marco Dorigo,Luca Maria Gambardella,Mauro

Birattari,Alcherio Martinoli,Riccardo Poli,Thomas Stützle,2006-08-29 This book constitutes the refereed proceedings of the 5th International Workshop on Ant Colony Optimization and Swarm Intelligence ANTS 2006 held in Brussels Belgium in September 2006 The 27 revised full papers 23 revised short papers and 12 extended abstracts presented were carefully reviewed and selected from 115 submissions

*Ant Colony Optimization and Swarm Intelligence* Marco Dorigo,Mauro Birattari,Christian Blum,Maurice Clerc,Thomas Stützle,Alan Winfield,2008-09-20 The series of biannual international

conferences ANTS International Conference on Ant Colony Optimization and Swarm Intelligence now in its sixth edition was started ten years ago with the organization of ANTS 98. As some readers might recall the first edition of ANTS was titled ANTS 98 From Ant Colonies to Artificial Ants First International Workshop on Ant Colony Optimization. In fact at that time the focus was mainly on ant colony optimization (ACO) the first swarm intelligence algorithm to go beyond a pure scientific interest and to enter the realm of real world applications. Interestingly in the ten years after the first edition there has been a growing interest not only for ACO but for a number of other studies that belong more generally to the area of swarm intelligence. The rapid growth of the swarm intelligence field is attested by a number of indicators. First the number of submissions and participants to the ANTS conferences has steadily increased over the years. Second a number of international conferences in computational intelligence and related disciplines organize workshops on subjects such as swarm intelligence, ant algorithms, ant colony optimization and particle swarm optimization. Third IEEE started organizing in 2003 the IEEE Swarm Intelligence Symposium in order to maintain unity in this growing field we are currently establishing a cooperation agreement between IEEE SIS and ANTS so as to have 1 IEEE SIS in odd years and ANTS in even years. Last the Swarm Intelligence journal was born.

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.

### **Long Term Open Pit Planning by Ant Colony**

**Optimization** Javad Sattarvand,2009    **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    *Ant Colony Optimization* Avi Ostfeld,2011-02-04 Ants communicate information by leaving pheromone tracks A moving ant leaves in varying quantities some pheromone on the ground to mark its way While an isolated ant moves essentially at random an ant encountering a previously laid trail is able to detect it and decide with high probability to follow it thus reinforcing the track with its own pheromone The collective behavior that emerges is thus a positive feedback where the more the ants following a track the more attractive that track becomes for being followed thus the probability with which an ant chooses a path increases with the number of ants that previously chose the same path This elementary ant s behavior inspired the development of ant colony optimization by Marco Dorigo in 1992 constructing a meta heuristic stochastic combinatorial computational methodology belonging to a family of related meta heuristic methods such as simulated annealing Tabu search and genetic algorithms This book covers in twenty chapters state of the art methods and applications of utilizing ant colony optimization algorithms New methods and theory such as multi colony ant algorithm based upon a new pheromone arithmetic crossover and a repulsive operator new findings on ant colony convergence and a diversity of engineering and science applications from transportation water resources

electrical and computer science disciplines are presented

*Ant Colony Optimization (ACO) Algorithm for CNC Route*

*Problem* Wan Nur Farhanah Wan Zakaria,2012

**Sine Cosine Algorithm for Optimization** Jagdish Chand Bansal,Prathu

Bajpai,Anjali Rawat,Atulya K. Nagar,2023-01-30 This open access book serves as a compact source of information on sine

cosine algorithm SCA and a foundation for developing and advancing SCA and its applications SCA is an easy user friendly

and strong candidate in the field of metaheuristics algorithms Despite being a relatively new metaheuristic algorithm it has

achieved widespread acceptance among researchers due to its easy implementation and robust optimization capabilities Its

effectiveness and advantages have been demonstrated in various applications ranging from machine learning engineering

design and wireless sensor network to environmental modeling The book provides a comprehensive account of the SCA

including details of the underlying ideas the modified versions various applications and a working MATLAB code for the basic SCA

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