Volume 8

Evolutionary Computation with Biogeography-based Optimization

Haiping Ma and Dan Simon

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A.E. Eiben,J.E. Smith

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Evolutionary Optimization Algorithms Dan Simon,2013-06-13 A clear and lucid bottom up approach to the basic principles of evolutionary algorithms Evolutionary algorithms EAs are a type of artificial intelligence EAs are motivated by optimization processes that we observe in nature such as natural selection species migration bird swarms human culture and ant colonies This book discusses the theory history mathematics and programming of evolutionary optimization algorithms Featured algorithms include genetic algorithms genetic programming ant colony optimization particle swarm optimization differential evolution biogeography based optimization and many others Evolutionary Optimization Algorithms Provides a straightforward bottom up approach that assists the reader in obtaining a clear but theoretically rigorous understanding of evolutionary algorithms with an emphasis on implementation Gives a careful treatment of recently developed EAs including opposition based learning artificial fish swarms bacterial foraging and many others and discusses their similarities and differences from more well established EAs Includes chapter end problems plus a solutions manual available online for instructors Offers simple examples that provide the reader with an intuitive understanding of the theory Features source code for the examples available on the author s website Provides advanced mathematical techniques for analyzing EAs including Markov modeling and dynamic system modeling Evolutionary Optimization Algorithms Biologically Inspired and Population Based Approaches to Computer Intelligence is an ideal text for advanced undergraduate students graduate students and professionals involved in engineering and computer science **Advances in Swarm Intelligence** KAY CHEN TAN,2010-06-08 This book and its companion volume LNCS vols 6145 and 6146 constitute the proceedings of the International Conference on Swarm Intelligence ICSI 2010 held in Beijing the capital of China during June 12 15 2010 ICSI 2010 was the rst gathering in the world for researchers working on all aspects of swarm intelligence and providedan academic forum for the participants to disseminate theirnewresearch ndingsanddiscussemergingareasofresearch Italsocreated a stimulating environment for the participants to interact and exchange inf mation on future challenges and opportunities of swarm intelligence research ICSI 2010 received 394 submissions from about 1241 authors in 22 countries and regions Australia Belgium Brazil Canada China Cyprus Hong Kong Hungary India Islamic Republic of Iran Japan Jordan Republic of Korea Malaysia Mexico Norway Pakistan South Africa Chinese Taiwan UK USA Vietnam across six continents Asia Europe North America South America Africa and Oceania Each submission was reviewed by at least three reviewers Based on rigorous reviews by the Program Committee members and reviewers 185 high quality papers were selected for publication in the proceedings with the acceptance rate of 46 9% The papers are organized in 25 cohesive sections covering all major topics of swarm intelligence research and development *Optimal Coordination of Power Protective Devices with Illustrative Examples* Ali R. Al-Roomi,2021-11-30 Optimal Coordination of Power Protective Devices with Illustrative Examples Provides practical guidance on the coordination issue of power protective relays and fuses Protecting electrical

power systems requires devices that isolate the components that are under fault while keeping the rest of the system stable Optimal Coordination of Power Protective Devices with Illustrative Examples provides a thorough introduction to the optimal coordination of power systems protection using fuses and protective relays Integrating fundamental theory and real world practice the text begins with an overview of power system protection and optimization followed by a systematic description of the essential steps in designing optimal coordinators using only directional overcurrent relays Subsequent chapters present mathematical formulations for solving many standard test systems and cover a variety of popular hybrid optimization schemes and their mechanisms The author also discusses a selection of advanced topics and extended applications including adaptive optimal coordination optimal coordination with multiple time current curves and optimally coordinating multiple types of protective devices Optimal Coordination of Power Protective Devices Covers fuses and overcurrent directional overcurrent and distance relays Explains the relation between fault current and operating time of protective relays Discusses performance and design criteria such as sensitivity speed and simplicity Includes an up to date literature review and a detailed overview of the fundamentals of power system protection Features numerous illustrative examples practical case studies and programs coded in MATLAB programming language Optimal Coordination of Power Protective Devices with Illustrative Examples is the perfect textbook for instructors in electric power system protection courses and a must have reference for protection engineers in power electric companies and for researchers and industry professionals specializing in power system protection **Evolutionary Computation with Biogeography-based Optimization** Haiping Ma,Dan Simon,2017-01-19 Evolutionary computation algorithms are employed to minimize functions with large number of variables Biogeography based optimization BBO is an optimization algorithm that is based on the science of biogeography which researches the migration patterns of species These migration paradigms provide the main logic behind BBO Due to the cross disciplinary nature of the optimization problems there is a need to develop multiple approaches to tackle them and to study the theoretical reasoning behind their performance This book explains the mathematical model of BBO algorithm and its variants created to cope with continuous domain problems with and without constraints and combinatorial problems

Oppositional Biogeography-based Optimization Mehmet Ergezer,OhioLINK Electronic Theses and Dissertations Center,2014 Abstract This dissertation outlines a novel variation of biogeography based optimization BBO which is an evolutionary algorithm EA developed for global optimization The new algorithm employs opposition based learning OBL alongside BBO migration to create oppositional BBO OB BO Additionally a new opposition method named quasi reflection is introduced Quasireflection is based on opposite numbers theory and we mathematically prove that it has the highest expected probability of being closer to the problem solution among all OBL methods that we explore Performance of quasi opposition is validated by mathematical analysis for a single dimensional problem and by simulations for higher dimensions Experiments are performed on benchmark problems taken from the literature as well as real world optimization problems

provided by the European Space Agency Empirical results demonstrate that with the assistance of quasi reflection OB BO significantly outperforms BBO in terms of success rate and the number of fitness function evaluations required to find an optimal solution for a set of standard continuous domain benchmarks The oppositional algorithm is further revised by the addition of fitness dependent quasi reflection which gives a candidate solution that we call xKr In this algorithm the amount of reflection is based on the fitness of the individual and can be non uniform We find that for small reflection weights xKr has a higher probability of being closer to the solution but only by a negligible amount As the reflection weight increases xKr gets closer on average to the solution of an optimization problem as the probability of being closer decreases In addition we extend the idea of opposition to combinatorial problems We introduce two different methods of opposition to solve two types of combinatorial optimization problems The first technique open path opposition is suited for combinatorial problems where the final node in the graph does not have be connected to the first node such as the graph coloring problem The latter technique circular opposition can be employed for problems where the endpoints of a graph are linked such as the well known traveling salesman problem TSP Both discrete opposition methods have been hybridized with biogeography based optimization BBO Simulations on standard graph coloring and TSP benchmarks illustrate that incorporating opposition into BBO improves performance   **Biogeography-Based Optimization: Algorithms and Applications** Yujun Zheng,Xueqin Lu,Minxia Zhang,Shengyong Chen,2018-09-14 This book introduces readers to the background general framework main operators and other basic characteristics of biogeography based optimization BBO which is an emerging branch of bio inspired computation In particular the book presents the authors recent work on improved variants of BBO hybridization of BBO with other algorithms and the application of BBO to a variety of domains including transportation image processing and neural network learning The content will help to advance research into and application of not only BBO but also the whole field of bio inspired computation The algorithms and applications are organized in a step by step manner and clearly described with the help of pseudo codes and flowcharts The readers will learn not only the basic concepts of BBO but also how to apply and adapt the algorithms to the engineering optimization problems they actually encounter

Biogeography-based Optimization for Combinatorial Problems and Complex Systems Dawei Du,Cleveland State University. Department of Electrical and Computer Engineering,OhioLINK Electronic Theses and Dissertations Center,2014 Abstract Biogeography based optimization BBO is a heuristic evolutionary algorithm that has shown good performance on many problems In this dissertation three problem1s 1 are researched for BBO convergence speed and optimal solution convergence of BBO 1 1BBO application to combinatorial problems and BBO application to complex systems The first problem is to analyze BBO from two perspectives how the components of BBO affect its convergence speed and the reason that BBO converges to the optimal solution For the first perspective which is convergence speed we analyze the two essential components of BBO population construction and information sharing For the second perspective a mathematical BBO model

is built to theoretically prove why BBO is capable of reaching the global optimum for any problem In the second problem addressed by the dissertation BBO is applied to combinatorial problems Our research includes the study of migration local search population initialization and greedy methods for combinatorial problems We conduct a series of simulations based on four benchmarks the sizes of which vary from small to extra large The simulation results indicate that when combined with other techniques the performance of BBO can be significantly improved Also a BBO graphical user interface GUI is created for combinatorial problems which is an intuitive way to experiment with BBO algorithms including hybrid BBO algorithms The third and final problem addressed in this dissertation is the optimization of complex systems We invent a new algorithm for complex system optimization based on BBO which is called BBO complex Four real world problems are used to test BBO Complex and compare with other complex system optimization algorithms and we obtain encouraging results from BBO Complex Then a Markov model is created for BBO Complex Simulation results are provided to confirm the model

Biogeography-based Optimization Dawei Du,2009 Biogeography based optimization BBO is a recently developed heuristic algorithm which has shown impressive performance on many well known benchmarks The aim of this thesis is to modify BBO in different ways First in order to improve BBO this thesis incorporates distinctive techniques from other successful heuristic algorithms into BBO The techniques from evolutionary strategy ES are used for BBO modification Second the traveling salesman problem TSP is a widely used benchmark in heuristic algorithms and it is considered as a standard benchmark in heuristic computations Therefore the main task in this part of the thesis is to modify BBO to solve the TSP then to make a comparison with genetic algorithms GAs Third most heuristic algorithms are designed for noiseless environments Therefore BBO is modified to operate in a noisy environment with the aid of a Kalman filter This involves probability calculations therefore BBO can choose the best option in its immigration step **Evolutionary Computation** Kenneth A. De Jong,2006-02-03 This text is an introduction to the field of evolutionary computation It approaches evolution strategies and genetic programming as instances of a more general class of evolutionary algorithms Evolutionary Computation Wellington Santos,2009-10-01 This book presents several recent advances on Evolutionary Computation specially evolution based optimization methods and hybrid algorithms for several applications from optimization and learning to pattern recognition and bioinformatics This book also presents new algorithms based on several analogies and metafores where one of them is based on philosophy specifically on the philosophy of praxis and dialectics In this book it is also presented interesting applications on bioinformatics specially the use of particle swarms to discover gene expression patterns in DNA microarrays Therefore this book features representative work on the field of evolutionary computation and applied sciences The intended audience is graduate undergraduate researchers and anyone who wishes to become familiar with the latest research work on this field **Introduction to Evolutionary Computing** A.E. Eiben,J.E. Smith,2007-08-06 The first complete overview of evolutionary computing the collective name for a range of problem solving techniques based on

principles of biological evolution such as natural selection and genetic inheritance The text is aimed directly at lecturers and graduate and undergraduate students It is also meant for those who wish to apply evolutionary computing to a particular problem or within a given application area The book contains quick reference information on the current state of the art in a wide range of related topics so it is of interest not just to evolutionary computing specialists but to researchers working in other fields **Evolutionary Algorithms** Alain Petrowski,Sana Ben-Hamida,2017-04-11 Evolutionary algorithms are bio inspired algorithms based on Darwin s theory of evolution They are expected to provide non optimal but good quality solutions to problems whose resolution is impracticable by exact methods In six chapters this book presents the essential knowledge required to efficiently implement evolutionary algorithms Chapter 1 describes a generic evolutionary algorithm as well as the basic operators that compose it Chapter 2 is devoted to the solving of continuous optimization problems without constraint Three leading approaches are described and compared on a set of test functions Chapter 3 considers continuous optimization problems with constraints Various approaches suitable for evolutionary methods are presented Chapter 4 is related to combinatorial optimization It provides a catalog of variation operators to deal with order based problems Chapter 5 introduces the basic notions required to understand the issue of multi objective optimization and a variety of approaches for its application Finally Chapter 6 describes different approaches of genetic programming able to evolve computer programs in the context of machine learning **Frontiers of Evolutionary Computation** Anil Menon,2004-02-29 The articles feature a mixture of informal discussion interspersed with formal statements thus providing the reader an opportunity to observe a wide range of EC problems from the investigative perspective of world renowned researchers **Evolutionary Computation for Modeling and Optimization** Daniel Ashlock,2005-12-15 Concentrates on developing intuition about evolutionary computation and problem solving skills and tool sets Lots of applications and test problems including a biotechnology chapter **Evolutionary Optimization** Ruhul Sarker,Masoud Mohammadian,Xin Yao,2002-01-31 The use of evolutionary computation techniques has grown considerably over the past several years Over this time the use and applications of these techniques have been further enhanced resulting in a set of computational intelligence also known as modern heuristics tools that are particularly adept for solving complex optimization problems Moreover they are characteristically more robust than traditional methods based on formal logics or mathematical programming for many real world OR MS problems Hence evolutionary computation techniques have dealt with complex optimization problems better than traditional optimization techniques although they can be applied to easy and simple problems where conventional techniques work well Clearly there is a need for a volume that both reviews state of the art evolutionary computation techniques and surveys the most recent developments in their use for solving complex OR MS problems This volume on Evolutionary Optimization seeks to fill this need Evolutionary Optimization is a volume of invited papers written by leading researchers in the field All papers were peer reviewed by at least two recognized reviewers The book covers the foundation

as well as the practical side of evolutionary optimization   Evolutionary Computation Techniques: A Comparative Perspective Erik Cuevas,Valentín Osuna,Diego Oliva,2016-12-28 This book compares the performance of various evolutionary computation EC techniques when they are faced with complex optimization problems extracted from different engineering domains Particularly focusing on recently developed algorithms it is designed so that each chapter can be read independently Several comparisons among EC techniques have been reported in the literature however they all suffer from one limitation their conclusions are based on the performance of popular evolutionary approaches over a set of synthetic functions with exact solutions and well known behaviors without considering the application context or including recent developments In each chapter a complex engineering optimization problem is posed and then a particular EC technique is presented as the best choice according to its search characteristics Lastly a set of experiments is conducted in order to compare its performance to other popular EC methods   *Knowledge Incorporation in Evolutionary Computation* Yaochu Jin,2004-10-20 Incorporation of a priori knowledge such as expert knowledge meta heuristics and human preferences as well as domain knowledge acquired during evolu tionary search into evolutionary algorithms has received increasing interest in the recent years It has been shown from various motivations that knowl edge incorporation into evolutionary search is able to significantly improve search efficiency However results on knowledge incorporation in evolution ary computation have been scattered in a wide range of research areas and a systematic handling of this important topic in evolutionary computation still lacks This edited book is a first attempt to put together the state of art and re cent advances on knowledge incorporation in evolutionary computation within a unified framework Existing methods for knowledge incorporation are di vided into the following five categories according to the functionality of the incorporated knowledge in the evolutionary algorithms 1 Knowledge incorporation in representation population initialization combination and mutation 2 Knowledge incorporation in selection and reproduction 3 Knowledge incorporation in fitness evaluations 4 Knowledge incorporation through life time learning and human computer interactions 5 Incorporation of human preferences in multi objective evolutionary com putation The intended readers of this book are graduate students researchers and practitioners in all fields of science and engineering who are interested in evolutionary computation The book is divided into six parts Part I contains one introductory chapter titled A selected introduction to evolutionary computation by Yao which presents a concise but insightful introduction to evolutionary computation   Evolutionary Computation for Dynamic Optimization Problems Shengxiang Yang,Xin Yao,2013-11-18 This book provides a compilation on the state of the art and recent advances of evolutionary computation for dynamic optimization problems The motivation for this book arises from the fact that many real world optimization problems and engineering systems are subject to dynamic environments where changes occur over time Key issues for addressing dynamic optimization problems in evolutionary computation including fundamentals algorithm design theoretical analysis and real world applications are presented Evolutionary Computation for Dynamic Optimization

Problems is a valuable reference to scientists researchers professionals and students in the field of engineering and science particularly in the areas of computational intelligence nature and bio inspired computing and evolutionary computation

Evolutionary Computation: Theory And Applications Xin Yao,1999-11-22 Evolutionary computation is the study of computational systems which use ideas and get inspiration from natural evolution and adaptation This book is devoted to the theory and application of evolutionary computation It is a self contained volume which covers both introductory material and selected advanced topics The book can roughly be divided into two major parts the introductory one and the one on selected advanced topics Each part consists of several chapters which present an in depth discussion of selected topics A strong connection is established between evolutionary algorithms and traditional search algorithms This connection enables us to incorporate ideas in more established fields into evolutionary algorithms The book is aimed at a wide range of readers It does not require previous exposure to the field since introductory material is included It will be of interest to anyone who is interested in adaptive optimization and learning People in computer science artificial intelligence operations research and various engineering fields will find it particularly interesting   **Evolutionary Computation and Optimization Algorithms in Software Engineering: Applications and Techniques** Chis, Monica,2010-06-30 Evolutionary Computation and Optimization Algorithms in Software Engineering Applications and Techniques lays the foundation for the successful integration of evolutionary computation into software engineering It surveys techniques ranging from genetic algorithms to swarm optimization theory to ant colony optimization demonstrating their uses and capabilities These techniques are applied to aspects of software engineering such as software testing quality assessment reliability assessment and fault prediction models among others to providing researchers scholars and students with the knowledge needed to expand this burgeoning application

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