

Steiner Ratio

A Proof of the Gilbert-Pollak Conjecture on the Steiner Ratio

D.-Z. Du and F. K. Hwang

Algorithmica 1992

The Steiner Ratio Conjecture of Gilbert-Pollak May Still Be Open

N. Innami · B.H. Kim · Y. Mashiko · K. Shiohama

Algorithmica 2010

Steiner Ratio

**Peter Widmayer, Yinfeng Xu, Binhai
Zhu**



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The Steiner Ratio Dietmar Cieslik, 2013-03-14 Steiner's Problem concerns finding a shortest interconnecting network for a finite set of points in a metric space. A solution must be a tree which is called a Steiner Minimal Tree (SMT) and may contain vertices different from the points which are to be connected. Steiner's Problem is one of the most famous combinatorial geometrical problems but unfortunately it is very difficult in terms of combinatorial structure as well as computational complexity. However, if only a Minimum Spanning Tree (MST) without additional vertices in the interconnecting network is sought, then it is simple to solve. So it is of interest to know what the error is if an MST is constructed instead of an SMT. The worst case for this ratio running over all finite sets is called the Steiner ratio of the space. The book concentrates on investigating the Steiner ratio. The goal is to determine or at least estimate the Steiner ratio for many different metric spaces. The author shows that the description of the Steiner ratio contains many questions from geometry, optimization, and graph theory. Audience: Researchers in network design, applied optimization, and design of algorithms. *Discrete Geometry, Combinatorics and Graph Theory* Jin Akiyama, William Y.C. Chen, Mikio Kano, Xueliang Li, Qinglin Yu, 2007-06-26 This book constitutes the thoroughly refereed post-proceedings of the 7th China Japan Conference on Discrete Geometry, Combinatorics and Graph Theory (CJCDGCGT 2005) held in Tianjin, China, as well as in Xi'an, China, in November 2005. The 30 revised full papers address all current issues in discrete algorithmic geometry, combinatorics, and graph theory. **Handbook of Approximation Algorithms and Metaheuristics** Teofilo F. Gonzalez, 2007-05-15 Delineating the tremendous growth in this area, the Handbook of Approximation Algorithms and Metaheuristics covers fundamental theoretical topics as well as advanced practical applications. It is the first book to comprehensively study both approximation algorithms and metaheuristics. Starting with basic approaches, the handbook presents the methodologies to design and analyze efficient approximation algorithms for a large class of problems and to establish inapproximability results for another class of problems. It also discusses local search, neural networks, and metaheuristics as well as multiobjective problems, sensitivity analysis, and stability. After laying this foundation, the book applies the methodologies to classical problems in combinatorial optimization, computational geometry, and graph problems. In addition, it explores large-scale and emerging applications in networks, bioinformatics, VLSI, game theory, and data analysis. Undoubtedly sparking further developments in the field, this handbook provides the essential techniques to apply approximation algorithms and metaheuristics to a wide range of problems in computer science, operations research, computer engineering, and economics. Armed with this information, researchers can design and analyze efficient algorithms to generate near-optimal solutions for a wide range of computational intractable problems. *Encyclopedia of Optimization* Christodoulos A. Floudas, Panos M. Pardalos, 2008-09-04 The goal of the Encyclopedia of Optimization is to introduce the reader to a complete set of topics that show the spectrum of research, the richness of ideas, and the breadth of applications that has come from this field. The second edition builds on the success of

the former edition with more than 150 completely new entries designed to ensure that the reference addresses recent areas where optimization theories and techniques have advanced. Particularly heavy attention resulted in health science and transportation with entries such as Algorithms for Genomics Optimization and Radiotherapy Treatment Design and Crew Scheduling.

Computing in Euclidean Geometry Dingzhu Du, Frank Hwang, 1992. This book is a collection of surveys and exploratory articles about recent developments in the field of computational Euclidean geometry. The topics covered are a history of Euclidean geometry, Voronoi diagrams, randomized geometric algorithms, computational algebra, triangulations, machine proofs, topological designs, finite element mesh, computer aided geometric designs, and Steiner trees. Each chapter is written by a leading expert in the field and together they provide a clear and authoritative picture of what computational Euclidean geometry is and the direction in which research is going.

Design and Analysis of Approximation Algorithms Ding-Zhu Du, Ker-I Ko, Xiaodong Hu, 2011-11-18. This book is intended to be used as a textbook for graduate students studying theoretical computer science. It can also be used as a reference book for researchers in the area of design and analysis of approximation algorithms. Design and Analysis of Approximation Algorithms is a graduate course in theoretical computer science taught widely in the universities both in the United States and abroad. There are however very few textbooks available for this course. Among those available in the market, most books follow a problem oriented format that is they collected many important combinatorial optimization problems and their approximation algorithms and organized them based on the types or applications of problems such as geometric type problems, algebraic type problems, etc. Such arrangement of materials is perhaps convenient for a researcher to look for the problems and algorithms related to his/her work but is difficult for a student to capture the ideas underlying the various algorithms. In the new book proposed here we follow a more structured technique oriented presentation. We organize approximation algorithms into different chapters based on the design techniques for the algorithms so that the reader can study approximation algorithms of the same nature together. It helps the reader to better understand the design and analysis techniques for approximation algorithms and also helps the teacher to present the ideas and techniques of approximation algorithms in a more unified way.

Shortest Connectivity Dietmar Cieslik, 2006-06-02. The aim in this graduate level text is to outline the key mathematical concepts that underpin these important questions in applied mathematics. These concepts involve discrete mathematics, particularly graph theory, optimization, computer science, and several ideas in biology.

Computing in Euclidean Geometry Ding-Zhu Du, Frank Hwang, 1995. This book is a collection of surveys and exploratory articles about recent developments in the field of computational Euclidean geometry. Topics covered include the history of Euclidean geometry, Voronoi diagrams, randomized geometric algorithms, computational algebra, triangulations, machine proofs, topological designs, finite element mesh, computer aided geometric designs, and Steiner trees. This second edition contains three new surveys covering geometric constraint solving, computational geometry, and the exact computation paradigm.

Approximation and Complexity in Numerical

Optimization Panos M. Pardalos, 2013-06-29 There has been much recent progress in approximation algorithms for nonconvex continuous and discrete problems from both a theoretical and a practical perspective In discrete or combinatorial optimization many approaches have been developed recently that link the discrete universe to the continuous universe through geometric analytic and algebraic techniques Such techniques include global optimization formulations semidefinite programming and spectral theory As a result new approximate algorithms have been discovered and many new computational approaches have been developed Similarly for many continuous nonconvex optimization problems new approximate algorithms have been developed based on semidefinite programming and new randomization techniques On the other hand computational complexity originating from the interactions between computer science and numerical optimization is one of the major theories that have revolutionized the approach to solving optimization problems and to analyzing their intrinsic difficulty The main focus of complexity is the study of whether existing algorithms are efficient for the solution of problems and which problems are likely to be tractable The quest for developing efficient algorithms leads also to elegant general approaches for solving optimization problems and reveals surprising connections among problems and their solutions A conference on Approximation and Complexity in Numerical Optimization Continuous and Discrete Problems was held during February 28 to March 2 1999 at the Center for Applied Optimization of the University of Florida

Optimal Interconnection Trees in the Plane Marcus Brazil, Martin Zachariasen, 2015-04-13 This book explores fundamental aspects of geometric network optimisation with applications to a variety of real world problems It presents for the first time in the literature a cohesive mathematical framework within which the properties of such optimal interconnection networks can be understood across a wide range of metrics and cost functions The book makes use of this mathematical theory to develop efficient algorithms for constructing such networks with an emphasis on exact solutions Marcus Brazil and Martin Zachariasen focus principally on the geometric structure of optimal interconnection networks also known as Steiner trees in the plane They show readers how an understanding of this structure can lead to practical exact algorithms for constructing such trees The book also details numerous breakthroughs in this area over the past 20 years features clearly written proofs and is supported by 135 colour and 15 black and white figures It will help graduate students working mathematicians engineers and computer scientists to understand the principles required for designing interconnection networks in the plane that are as cost efficient as possible *Computing and Combinatorics* Joachim Gudmundsson, Julián Mestre, Taso Viglas, 2012-08-14 This book constitutes the refereed proceedings of the 18th Annual International Conference on Computing and Combinatorics held in Sydney Australia in August 2012 The 50 revised full papers presented were carefully reviewed and selected from 121 submissions Topics covered are algorithms and data structures algorithmic game theory and online algorithms automata languages logic and computability combinatorics related to algorithms and complexity complexity theory computational learning theory and knowledge discovery cryptography

reliability and security and database theory computational biology and bioinformatics computational algebra geometry and number theory graph drawing and information visualization graph theory communication networks and optimization

Algorithms and Computation Tetsuo Asano,1996-11-27 Today the cemented joint prosthesis operation is one of the most frequent procedures in orthopaedic surgery During the past 30 years the individual steps of such an operation have been carefully validated and thus allow for a reproducible and standardized operation including a reliable prognosis for the maintenance of the joint This manual is a practical guide to a complication preventing cementing technique cement fixation maintenance of the bone and diamond technique Clear drawings and diagrams guide the reader through the pre operative peri operative and post operative steps The manual covers all possible complications and gives clear instructions so as to prevent complications but also to cope with them if they occur Finally it covers all forensic criteria to be considered

Recent Advances in Optimization Peter Gritzmann,Reiner Horst,Ekkehard Sachs,Rainer Tichatschke,2012-12-06 This book presents recent theoretical and practical aspects in the field of optimization and convex analysis The topics covered in this volume include Equilibrium models in economics Control theory and semi infinite programming Ill posed variational problems Global optimization Variational methods in image restoration Nonsmooth optimization Duality theory in convex and nonconvex optimization Methods for large scale problems

Handbook of Combinatorial Optimization Ding-Zhu Du,Panos M. Pardalos,2006-08-18 Combinatorial or discrete optimization is one of the most active fields in the interface of operations research computer science and applied mathematics Combinatorial optimization problems arise in various applications including communications network design VLSI design machine vision a line crew scheduling corporate planning computer aided design and manufacturing database query design cellular telephone frequency assignment constraint directed reasoning and computational biology Furthermore combinatorial optimization problems occur in many diverse areas such as linear and integer programming graph theory artificial intelligence and number theory All these problems when formulated mathematically as the minimization or maximization of a certain function defined on some domain have a commonality of discreteness Historically combinatorial optimization starts with linear programming Linear programming has an entire range of important applications including production planning and distribution personnel assignment finance allocation of economic resources circuit simulation and control systems Leonid Kantorovich and Tjalling Koopmans received the Nobel Prize 1975 for their work on the optimal allocation of resources Two important discoveries the ellipsoid method 1979 and interior point approaches 1984 both provide polynomial time algorithms for linear programming These algorithms have had a profound effect in combinatorial optimization Many polynomial time solvable combinatorial optimization problems are special cases of linear programming e g matching and maximum flow In addition linear programming relaxations are often the basis for many approximation algorithms for solving NP hard problems e g dual heuristics

Combinatorial Optimization and Applications Peter Widmayer,Yinfeng Xu,Binhai Zhu,2013-11-21 This book constitutes the refereed proceedings of the 7th International

Conference on Combinatorial Optimization and Applications COCOA 2013 held in Chengdu China in December 2013 The 36 full papers presented were carefully reviewed and selected from 72 submissions The papers feature original research in the areas of combinatorial optimization and its applications In addition to theoretical results there are reports on experimental and applied research of general algorithmic interest Algorithms and Computation Xiaotie Deng,2005-12-09 This book constitutes the refereed proceedings of the 16th International Symposium on Algorithms and Computation ISAAC 2005 held in Sanya Hainan China in December 2005 The 112 revised full papers presented were carefully reviewed and selected from 549 submissions The papers are organized in topical sections on computational geometry computational optimization graph drawing and graph algorithms computational complexity approximation algorithms internet algorithms quantum computing and cryptography data structure computational biology experimental algorithm methodologies and online algorithms randomized algorithms parallel and distributed algorithms Discrete Geometry and Algebraic Combinatorics Alexander Barg,Oleg R. Musin,2014-08-28 This volume contains the proceedings of the AMS Special Session on Discrete Geometry and Algebraic Combinatorics held on January 11 2013 in San Diego California The collection of articles in this volume is devoted to packings of metric spaces and related questions and contains new results as well as surveys of some areas of discrete geometry This volume consists of papers on combinatorics of transportation polytopes including results on the diameter of graphs of such polytopes the generalized Steiner problem and related topics of the minimal fillings theory a survey of distance graphs and graphs of diameters and a group of papers on applications of algebraic combinatorics to packings of metric spaces including sphere packings and topics in coding theory In particular this volume presents a new approach to duality in sphere packing based on the Poisson summation formula applications of semidefinite programming to spherical codes and equiangular lines new results in list decoding of a family of algebraic codes and constructions of bent and semi bent functions Geometry and Topology Down Under Craig D. Hodgson,William H. Jaco,Martin G. Scharlemann,Stephan Tillmann,2013-08-23 This book contains the proceedings of the conference Geometry Topology Down Under held July 11 22 2011 at the University of Melbourne Parkville Australia in honour of Hyam Rubinstein The main topic of the book is low dimensional geometry and topology It includes both survey articles based on courses presented at the conferences and research articles devoted to important questions in low dimensional geometry Together these contributions show how methods from different fields of mathematics contribute to the study of 3 manifolds and Gromov hyperbolic groups It also contains a list of favorite problems by Hyam Rubinstein **Branching Solutions To One-dimensional Variational Problems** Alexandr Ivanov,Alexei Avgustinovich Tuzhilin,2001-01-17 This book deals with the new class of one dimensional variational problems the problems with branching solutions Instead of extreme curves mappings of a segment to a manifold we investigate extreme networks which are mappings of graphs one dimensional cell complexes to a manifold Various applications of the approach are presented such as several generalizations of the famous Steiner problem of finding the

shortest network spanning given points of the plane **Optimal Coverage in Wireless Sensor Networks** Weili Wu,Zhao Zhang,Wonjun Lee,Ding-Zhu Du,2020-09-30 This book will serve as a reference presenting state of the art research on theoretical aspects of optimal sensor coverage problems Readers will find it a useful tool for furthering developments on theory and applications of optimal coverage much of the content can serve as material for advanced topics courses at the graduate level The book is well versed with the hottest research topics such as Lifetime of Coverage Weighted Sensor Coverage k Coverage Heterogeneous Sensors Barrier Sweep and Partial Coverage Mobile Sensors Camera Sensors and Energy Harvesting Sensors and more Topics are introduced in a natural order from simple covers to connected covers to the lifetime problem Later the book begins revisiting earlier problems ranging from the introduction of weights to coverage by k sensors and partial coverage and from sensor heterogeneity to novel problems such as the barrier coverage problem The book ends with coverage of mobile sensors camera sensors energy harvesting sensors underwater sensors and crowdsensing

Unveiling the Power of Verbal Artistry: An Mental Sojourn through **Steiner Ratio**

In a world inundated with displays and the cacophony of quick interaction, the profound power and psychological resonance of verbal artistry often diminish into obscurity, eclipsed by the continuous onslaught of noise and distractions. Yet, nestled within the musical pages of **Steiner Ratio**, a interesting perform of literary splendor that pulses with natural thoughts, lies an unique trip waiting to be embarked upon. Composed with a virtuoso wordsmith, that magical opus instructions readers on an emotional odyssey, delicately exposing the latent potential and profound influence stuck within the complex internet of language. Within the heart-wrenching expanse of this evocative evaluation, we can embark upon an introspective exploration of the book is main themes, dissect their charming publishing style, and immerse ourselves in the indelible impact it leaves upon the depths of readers souls.

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