

STRATEGIES FOR QUASI- MONTE CARLO

Bennett L. Fox



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Strategies For Quasi Monte Carlo

**Kai-Tai Fang, Fred J. Hickernell, Harald
Niederreiter**



Strategies For Quasi Monte Carlo:

Strategies for Quasi-Monte Carlo Bennett L. Fox, 2011-09-26 Strategies for Quasi Monte Carlo builds a framework to design and analyze strategies for randomized quasi Monte Carlo RQMC One key to efficient simulation using RQMC is to structure problems to reveal a small set of important variables their number being the effective dimension while the other variables collectively are relatively insignificant Another is smoothing The book provides many illustrations of both keys in particular for problems involving Poisson processes or Gaussian processes RQMC beats grids by a huge margin With low effective dimension RQMC is an order of magnitude more efficient than standard Monte Carlo With in addition certain smoothness perhaps induced RQMC is an order of magnitude more efficient than deterministic QMC Unlike the latter RQMC permits error estimation via the central limit theorem For random dimensional problems such as occur with discrete event simulation RQMC gets judiciously combined with standard Monte Carlo to keep memory requirements bounded This monograph has been designed to appeal to a diverse audience including those with applications in queueing operations research computational finance mathematical programming partial differential equations both deterministic and stochastic and particle transport as well as to probabilists and statisticians wanting to know how to apply effectively a powerful tool and to those interested in numerical integration or optimization in their own right It recognizes that the heart of practical application is algorithms so pseudocodes appear throughout the book While not primarily a textbook it is suitable as a supplementary text for certain graduate courses As a reference it belongs on the shelf of everyone with a serious interest in improving simulation efficiency Moreover it will be a valuable reference to all those individuals interested in improving simulation efficiency with more than incremental increases

Monte Carlo and Quasi-Monte Carlo Methods in Scientific Computing Harald Niederreiter, Peter J. Shiue, 2012-12-06 Scientists and engineers are increasingly making use of simulation methods to solve problems which are insoluble by analytical techniques Monte Carlo methods which make use of probabilistic simulations are frequently used in areas such as numerical integration complex scheduling queueing networks and large dimensional simulations This collection of papers arises from a conference held at the University of Nevada Las Vegas in 1994 The conference brought together researchers across a range of disciplines whose interests include the theory and application of these methods This volume provides a timely survey of this field and the new directions in which the field is moving

Random Number Generation and Quasi-Monte Carlo Methods Harald Niederreiter, 1992-01-01 This volume contains recent work in uniform pseudorandom number generation and quasi Monte Carlo methods and stresses the interplay between them

Monte Carlo and Quasi-Monte Carlo Methods 2000 Kai-Tai Fang, Fred J. Hickernell, Harald Niederreiter, 2011-06-28 This book represents the refereed proceedings of the Fourth International Conference on Monte Carlo and Quasi Monte Carlo Methods in Scientific Computing which was held at Hong Kong Baptist University in 2000 An important feature are invited surveys of the state of the art in key areas such as

multidimensional numerical integration low discrepancy point sets random number generation and applications of Monte Carlo and quasi Monte Carlo methods These proceedings include also carefully selected contributed papers on all aspects of Monte Carlo and quasi Monte Carlo methods The reader will be informed about current research in this very active field

Monte Carlo and Quasi-Monte Carlo Methods 1996 Harald Niederreiter, Peter Hellekalek, Gerhard Larcher, Peter Zinterhof, 2012-12-06 Monte Carlo methods are numerical methods based on random sampling and quasi Monte Carlo methods are their deterministic versions This volume contains the refereed proceedings of the Second International Conference on Monte Carlo and Quasi Monte Carlo Methods in Scientific Computing which was held at the University of Salzburg Austria from July 9-12 1996 The conference was a forum for recent progress in the theory and the applications of these methods The topics covered in this volume range from theoretical issues in Monte Carlo and simulation methods low discrepancy point sets and sequences lattice rules and pseudorandom number generation to applications such as numerical integration numerical linear algebra integral equations binary search global optimization computational physics mathematical finance and computer graphics These proceedings will be of interest to graduate students and researchers in Monte Carlo and quasi Monte Carlo methods to numerical analysts and to practitioners of simulation methods

Monte Carlo and Quasi-Monte Carlo Methods 2002 Harald Niederreiter, 2011-06-28 This book represents the refereed proceedings of the Fifth International Conference on Monte Carlo and Quasi Monte Carlo Methods in Scientific Computing which was held at the National University of Singapore in the year 2002 An important feature are invited surveys of the state of the art in key areas such as multidimensional numerical integration low discrepancy point sets computational complexity finance and other applications of Monte Carlo and quasi Monte Carlo methods These proceedings also include carefully selected contributed papers on all aspects of Monte Carlo and quasi Monte Carlo methods The reader will be informed about current research in this very active area

Monte Carlo and Quasi-Monte Carlo Methods 2008 Pierre L'Ecuyer, Art B.

Owen, 2010-01-14 This book represents the refereed proceedings of the Eighth International Conference on Monte Carlo MC and Quasi Monte Carlo QMC Methods in Scientific Computing held in Montreal Canada in July 2008 It covers the latest theoretical developments as well as important applications of these methods in different areas It contains two tutorials eight invited articles and 32 carefully selected articles based on the 135 contributed presentations made at the conference This conference is a major event in Monte Carlo methods and is the premiere event for quasi Monte Carlo and its combination with Monte Carlo This series of proceedings volumes is the primary outlet for quasi Monte Carlo research

Handbook of Monte Carlo Methods Dirk P. Kroese, Thomas Taimre, Zdravko I. Botev, 2013-06-06 A comprehensive overview of Monte Carlo simulation that explores the latest topics techniques and real world applications More and more of today's numerical problems found in engineering and finance are solved through Monte Carlo methods The heightened popularity of these methods and their continuing development makes it important for researchers to have a comprehensive understanding of the

Monte Carlo approach Handbook of Monte Carlo Methods provides the theory algorithms and applications that helps provide a thorough understanding of the emerging dynamics of this rapidly growing field The authors begin with a discussion of fundamentals such as how to generate random numbers on a computer Subsequent chapters discuss key Monte Carlo topics and methods including Random variable and stochastic process generation Markov chain Monte Carlo featuring key algorithms such as the Metropolis Hastings method the Gibbs sampler and hit and run Discrete event simulation Techniques for the statistical analysis of simulation data including the delta method steady state estimation and kernel density estimation Variance reduction including importance sampling latin hypercube sampling and conditional Monte Carlo Estimation of derivatives and sensitivity analysis Advanced topics including cross entropy rare events kernel density estimation quasi Monte Carlo particle systems and randomized optimization The presented theoretical concepts are illustrated with worked examples that use MATLAB a related Web site houses the MATLAB code allowing readers to work hands on with the material and also features the author s own lecture notes on Monte Carlo methods Detailed appendices provide background material on probability theory stochastic processes and mathematical statistics as well as the key optimization concepts and techniques that are relevant to Monte Carlo simulation Handbook of Monte Carlo Methods is an excellent reference for applied statisticians and practitioners working in the fields of engineering and finance who use or would like to learn how to use Monte Carlo in their research It is also a suitable supplement for courses on Monte Carlo methods and computational statistics at the upper undergraduate and graduate levels

Contributions to the Theory of Monte Carlo and Quasi-Monte Carlo Methods Giray Okten, 1999 Quasi Monte Carlo methods which are often described as deterministic versions of Monte Carlo methods were introduced in the 1950s by number theoreticians They improve several deficiencies of Monte Carlo methods such as providing estimates with deterministic bounds and avoiding the paradoxical difficulty of generating random numbers in a computer However they have their own drawbacks First although they provide faster convergence than Monte Carlo methods asymptotically the advantage may not be practical to obtain in high dimensional problems Second there is not a practical way to measure the error of a quasi Monte Carlo simulation Finally unlike Monte Carlo methods there is a scarcity of error reduction techniques for these methods In this dissertation we attempt to provide remedies for the disadvantages of quasi Monte Carlo methods mentioned above In the first part of the dissertation a hybrid Monte Carlo sequence designed to obtain error reduction in high dimensions is studied Probabilistic results on the discrepancy of this sequence as well as results obtained by applying the sequence to problems from numerical integration and mathematical finance are presented In the second part of the dissertation a new hybrid Monte Carlo method is introduced in an attempt to obtain a practical statistical error analysis using low discrepancy sequences It is applied to problems from mathematical finance and particle transport theory to compare its effectiveness with the conventional methods In the last part of the dissertation a generalized quasi Monte Carlo integration rule is introduced A Koksma Hlawka type inequality for the rule is proved using a new concept

for the variation of a function As a consequence of the rule error reduction techniques and in particular an importance sampling type statement are derived Problems from different disciplines are used as practical tests for our methods The numerical results obtained in favor of the methods suggest the practical advantages that can be realized by their use in a wide variety of applications

Monte Carlo and Quasi-Monte Carlo Methods 2006 Alexander Keller, Stefan Heinrich, Harald Niederreiter, 2007-12-30 This book presents the refereed proceedings of the Seventh International Conference on Monte Carlo and Quasi Monte Carlo Methods in Scientific Computing held in Ulm Germany in August 2006 The proceedings include carefully selected papers on many aspects of Monte Carlo and quasi Monte Carlo methods and their applications They also provide information on current research in these very active areas

Uncertainty Quantification in Computational Fluid Dynamics and Aircraft Engines Francesco Montomoli, 2018-06-21 This book introduces design techniques developed to increase the safety of aircraft engines and demonstrates how the application of stochastic methods can overcome problems in the accurate prediction of engine lift caused by manufacturing error This in turn addresses the issue of achieving required safety margins when hampered by limits in current design and manufacturing methods The authors show that avoiding the potential catastrophe generated by the failure of an aircraft engine relies on the prediction of the correct behaviour of microscopic imperfections This book shows how to quantify the possibility of such failure and that it is possible to design components that are inherently less risky and more reliable This new updated and significantly expanded edition gives an introduction to engine reliability and safety to contextualise this important issue evaluates newly proposed methods for uncertainty quantification as applied to jet engines Uncertainty Quantification in Computational Fluid Dynamics and Aircraft Engines will be of use to gas turbine manufacturers and designers as well as CFD practitioners specialists and researchers Graduate and final year undergraduate students in aerospace or mathematical engineering may also find it of interest

Handbooks in Operations Research and Management Science: Simulation Shane G. Henderson, Barry L. Nelson, 2006-09-02 This Handbook is a collection of chapters on key issues in the design and analysis of computer simulation experiments on models of stochastic systems The chapters are tightly focused and written by experts in each area For the purpose of this volume simulation refers to the analysis of stochastic processes through the generation of sample paths realization of the processes Attention focuses on design and analysis issues and the goal of this volume is to survey the concepts principles tools and techniques that underlie the theory and practice of stochastic simulation design and analysis Emphasis is placed on the ideas and methods that are likely to remain an intrinsic part of the foundation of the field for the foreseeable future The chapters provide up to date references for both the simulation researcher and the advanced simulation user but they do not constitute an introductory level how to guide Computer scientists financial analysts industrial engineers management scientists operations researchers and many other professionals use stochastic simulation to design understand and improve communications financial manufacturing logistics and service systems A theme that runs throughout

these diverse applications is the need to evaluate system performance in the face of uncertainty including uncertainty in user load interest rates demand for product availability of goods cost of transportation and equipment failures

Tightly focused chapters written by experts Surveys concepts principles tools and techniques that underlie the theory and practice of stochastic simulation design and analysis Provides an up to date reference for both simulation researchers and advanced simulation users

Numerical Methods for Stochastic Computations Dongbin Xiu,2010-07-01 The first graduate level textbook to focus on fundamental aspects of numerical methods for stochastic computations this book describes the class of numerical methods based on generalized polynomial chaos gPC These fast efficient and accurate methods are an extension of the classical spectral methods of high dimensional random spaces Designed to simulate complex systems subject to random inputs these methods are widely used in many areas of computer science and engineering The book introduces polynomial approximation theory and probability theory describes the basic theory of gPC methods through numerical examples and rigorous development details the procedure for converting stochastic equations into deterministic ones using both the Galerkin and collocation approaches and discusses the distinct differences and challenges arising from high dimensional problems The last section is devoted to the application of gPC methods to critical areas such as inverse problems and data assimilation Ideal for use by graduate students and researchers both in the classroom and for self study

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Monte-Carlo and Quasi-Monte Carlo Methods 1998 Harald Niederreiter,Jerome Spanier,2000 This book represents the refereed proceedings of the Third International Conference on Monte Carlo and Quasi Monte Carlo Methods in Scientific Computing which was held at Claremont Graduate University in 1998 An important feature are invited surveys of the state of the art in key areas such as multidimensional numerical integration low discrepancy point sets random number generation and applications of Monte Carlo and quasi Monte Carlo methods These proceedings include also carefully selected contributed papers on all aspects of Monte Carlo and quasi Monte Carlo methods The reader will be informed about current research in this very active area

Information Computing And Automation (In 3 Volumes) - Proceedings Of The International Conference Jian Ping Li,Igor Bloshanskii,Lionel M Ni,S S Pandey,Simon X Yang,2008-04-25 Wavelet analysis and its applications have become one of the fastest growing research areas in the past several years Wavelet theory has been employed in many fields and applications such as signal and image processing communication systems biomedical imaging radar air acoustics and endless other areas Active media technology is concerned with the development of autonomous computational or physical entities capable of perceiving reasoning adapting learning cooperating and delegating in a dynamic environment This book consists of carefully

selected and received papers presented at the conference and is an attempt to capture the essence of the current state of the art in wavelet analysis and active media technology Invited papers included in this proceedings includes contributions from Prof P Zhang T D Bui and C Y Suen from Concordia University Canada Prof N A Strelkov and V L Dol nikov from Yaroslavl State University Russia Prof Chin Chen Chang and Ching Yun Chang from Taiwan Prof S S Pandey from R D University India and Prof I L Bloshanskii from Moscow State Regional University Russia

Optimization and Inverse Problems in Electromagnetism Marek Rudnicki, Slawomir Wiak, 2013-04-17 From 12 to 14 September 2002 the Academy of Humanities and Economics AHE hosted the workshop Optimization and Inverse Problems in Electromagnetism After this bi annual event a large number of papers were assembled and combined in this book During the workshop recent developments and applications in optimization and inverse methodologies for electromagnetic fields were discussed The contributions selected for the present volume cover a wide spectrum of inverse and optimal electromagnetic methodologies ranging from theoretical to practical applications A number of new optimal and inverse methodologies were proposed There are contributions related to dedicated software Optimization and Inverse Problems in Electromagnetism consists of three thematic chapters covering General papers survey of specific aspects of optimization and inverse problems in electromagnetism Methodologies Industrial Applications The book can be useful to students of electrical and electronics engineering computer science applied mathematics PhD level and to researchers interested in the topic

Numerical Methods and Applications Todor Boyanov, 2007-02-20 This book constitutes the thoroughly refereed post proceedings of the 6th International Conference on Numerical Methods and Applications NMA 2006 held in Borovets Bulgaria in August 2006 The 84 revised full papers presented together with 3 invited papers were carefully reviewed and selected from 111 submissions The papers are organized in topical sections on numerical methods for hyperbolic problems robust preconditioning solution methods Monte Carlo and quasi Monte Carlo for diverse applications metaheuristics for optimization problems uncertain control systems and reliable numerics interpolation and quadrature processes large scale computations in environmental modelling and contributed talks

Modeling Uncertainty Moshe Dror, Pierre L'Ecuyer, Ferenc Szidarovszky, 2019-11-05 Modeling Uncertainty An Examination of Stochastic Theory Methods and Applications is a volume undertaken by the friends and colleagues of Sid Yakowitz in his honor Fifty internationally known scholars have collectively contributed 30 papers on modeling uncertainty to this volume Each of these papers was carefully reviewed and in the majority of cases the original submission was revised before being accepted for publication in the book The papers cover a great variety of topics in probability statistics economics stochastic optimization control theory regression analysis simulation stochastic programming Markov decision process application in the HIV context and others There are papers with a theoretical emphasis and others that focus on applications A number of papers survey the work in a particular area and in a few papers the authors present their personal view of a topic It is a book with a considerable number of expository articles

which are accessible to a nonexpert a graduate student in mathematics statistics engineering and economics departments or just anyone with some mathematical background who is interested in a preliminary exposition of a particular topic Many of the papers present the state of the art of a specific area or represent original contributions which advance the present state of knowledge In sum it is a book of considerable interest to a broad range of academic researchers and students of stochastic systems

Kernel-based Approximation Methods Using Matlab Gregory E Fasshauer, Michael J Mccourt, 2015-07-30 In an attempt to introduce application scientists and graduate students to the exciting topic of positive definite kernels and radial basis functions this book presents modern theoretical results on kernel based approximation methods and demonstrates their implementation in various settings The authors explore the historical context of this fascinating topic and explain recent advances as strategies to address long standing problems Examples are drawn from fields as diverse as function approximation spatial statistics boundary value problems machine learning surrogate modeling and finance Researchers from those and other fields can recreate the results within using the documented MATLAB code also available through the online library This combination of a strong theoretical foundation and accessible experimentation empowers readers to use positive definite kernels on their own problems of interest

Analyzing Analytics Rajesh Bordawekar, Bob Blainey, Ruchir Puri, 2022-05-31 This book aims to achieve the following goals 1 to provide a high level survey of key analytics models and algorithms without going into mathematical details 2 to analyze the usage patterns of these models and 3 to discuss opportunities for accelerating analytics workloads using software hardware and system approaches The book first describes 14 key analytics models exemplars that span data mining machine learning and data management domains For each analytics exemplar we summarize its computational and runtime patterns and apply the information to evaluate parallelization and acceleration alternatives for that exemplar Using case studies from important application domains such as deep learning text analytics and business intelligence BI we demonstrate how various software and hardware acceleration strategies are implemented in practice This book is intended for both experienced professionals and students who are interested in understanding core algorithms behind analytics workloads It is designed to serve as a guide for addressing various open problems in accelerating analytics workloads e g new architectural features for supporting analytics workloads impact on programming models and runtime systems and designing analytics systems

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