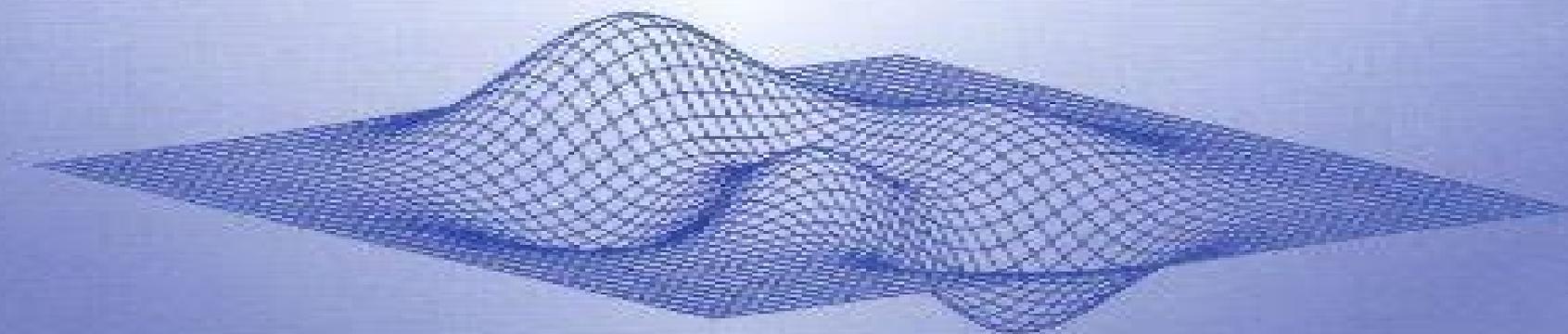


NONCONVEX OPTIMIZATION AND ITS APPLICATIONS

Stochastic Approximation and Its Applications

Han-Fu Chen



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Stochastic Approximation And Its Applications

Harold Kushner, G. George Yin



Stochastic Approximation And Its Applications:

Stochastic Approximation and Its Applications Han-Fu Chen, 2005-12-30 Estimating unknown parameters based on observation data containing information about the parameters is ubiquitous in diverse areas of both theory and application. For example, in system identification the unknown system coefficients are estimated on the basis of input-output data of the control system; in adaptive control systems the adaptive control gain should be defined based on observation data in such a way that the gain asymptotically tends to the optimal one; in blind channel identification the channel coefficients are estimated using the output data obtained at the receiver; in signal processing the optimal weighting matrix is estimated on the basis of observations; in pattern classification the parameters specifying the partition hyperplane are searched by learning, and more examples may be added to this list. All these parameter estimation problems can be transformed to a root-seeking problem for an unknown function. To see this, let note the observation at time i , i.e. the information available about the unknown parameters at time i . It can be assumed that the parameter under estimation denoted by θ is a root of some unknown function. This is not a restriction because, for example, $\theta^T x_i$ may serve as such a function.

Stochastic Approximation and Its Applications Han-Fu Chen, 2010-12-10 Estimating unknown parameters based on observation data containing information about the parameters is ubiquitous in diverse areas of both theory and application. For example, in system identification the unknown system coefficients are estimated on the basis of input-output data of the control system; in adaptive control systems the adaptive control gain should be defined based on observation data in such a way that the gain asymptotically tends to the optimal one; in blind channel identification the channel coefficients are estimated using the output data obtained at the receiver; in signal processing the optimal weighting matrix is estimated on the basis of observations; in pattern classification the parameters specifying the partition hyperplane are searched by learning, and more examples may be added to this list. All these parameter estimation problems can be transformed to a root-seeking problem for an unknown function. To see this, let note the observation at time i , i.e. the information available about the unknown parameters at time i . It can be assumed that the parameter under estimation denoted by θ is a root of some unknown function. This is not a restriction because, for example, $\theta^T x_i$ may serve as such a function.

Stochastic approximation and its applications Madanlal T. Wasan, 1967

Stochastic Approximation and Recursive Algorithms and Applications Harold Kushner, G. George Yin, 2006-05-04 The basic stochastic approximation algorithms introduced by Robbins and Monro and by Kiefer and Wolfowitz in the early 1950s have been the subject of an enormous literature, both theoretical and applied. This is due to the large number of applications and the interesting theoretical issues in the analysis of dynamically defined stochastic processes. The basic paradigm is a stochastic difference equation such as $Y_{n+1} = Y_n + \alpha_n (Z_n - \theta)$ where Y_n takes values in some Euclidean space, Y_0 is a random variable, and the step size α_n is small and might go to zero as $n \rightarrow \infty$. In its simplest form, θ is a parameter of a system and the random vector Z_n is a function of n noise-corrupted observations taken on the system when

the parameter is set to One recursively adjusts the parameter so that some goal is met n asymptotically
 This book is concerned with the qualitative and asymptotic properties of such recursive algorithms in the diverse forms in which they arise in applications There are analogous continuous time algorithms but the conditions and proofs are generally very close to those for the discrete time case The original work was motivated by the problem of finding a root of a continuous function g where the function is not known but the experimenter is able to take noisy measurements at any desired value of x
 Recursive methods for root finding are common in classical numerical analysis and it is reasonable to expect that appropriate stochastic analogs would also perform well

Stochastic Approximation and Optimization of Random Systems L. Ljung, G. Pflug, H. Walk, 2012-12-06 The DMV seminar Stochastische Approximation und Optimierung zufälliger Systeme was held at Blaubeuren 28 5 4 6 1989 The goal was to give an approach to theory and application of stochastic approximation in view of optimization problems especially in engineering systems These notes are based on the seminar lectures They consist of three parts I Foundations of stochastic approximation H Walk n Applicational aspects of stochastic approximation G Pflug In Applications to adaptation algorithms L Ljung The prerequisites for reading this book are basic knowledge in probability mathematical statistics optimization We would like to thank Prof M Barner and Prof G Fischer for the organization of the seminar We also thank the participants for their cooperation and our assistants and secretaries for typing the manuscript November 1991 L Ljung G Pflug H Walk Table of contents I Foundations of stochastic approximation H Walk 1 Almost sure convergence of stochastic approximation procedures 2 2 Recursive methods for linear problems 17 3 Stochastic optimization under stochastic constraints 22 4 A learning model recursive density estimation 27 5 Invariance principles in stochastic approximation 30 6 On the theory of large deviations 43 References for Part I 45 11 Applicational aspects of stochastic approximation G Pflug 7 Markovian stochastic optimization and stochastic approximation procedures 53 8 Asymptotic distributions 71 9 Stopping times 79 10 Applications of stochastic approximation methods 80 References for Part II 90 III Applications to adaptation algorithms L

Multidimensional Stochastic Approximation and Its Applications to Detection and Estimation Anthony Katopis, 1973

Stochastic Approximation and Optimization of Random Systems Lennart Ljung, Georg Ch. Pflug, Harro Walk, 1992-03-31 The DMV seminar Stochastische Approximation und Optimierung zufälliger Systeme was held at Blaubeuren 28 5 4 6 1989 The goal was to give an approach to theory and application of stochastic approximation in view of optimization problems especially in engineering systems These notes are based on the seminar lectures They consist of three parts I Foundations of stochastic approximation H Walk n Applicational aspects of stochastic approximation G Pflug In Applications to adaptation algorithms L Ljung The prerequisites for reading this book are basic knowledge in probability mathematical statistics optimization We would like to thank Prof M Barner and Prof G Fischer for the organization of the seminar We also thank the participants for their cooperation and our assistants and secretaries for typing the manuscript November 1991 L Ljung G Pflug H Walk Table of contents I Foundations of stochastic approximation H Walk 1 Almost sure

convergence of stochastic approximation procedures 2 2 Recursive methods for linear problems 17 3 Stochastic optimization under stochastic constraints 22 4 A learning model recursive density estimation 27 5 Invariance principles in stochastic approximation 30 6 On the theory of large deviations 43 References for Part I 45 11 Application aspects of stochastic approximation G PHug 7 Markovian stochastic optimization and stochastic approximation procedures 53 8 Asymptotic distributions 71 9 Stopping times 79 10 Applications of stochastic approximation methods 80 References for Part II 90 III Applications to adaptation algorithms L

Martingale Limit Theory and Its Application P. Hall, C. C. Heyde, 2014-07-10 *Martingale Limit Theory and Its Application* discusses the asymptotic properties of martingales particularly as regards key prototype of probabilistic behavior that has wide applications The book explains the thesis that martingale theory is central to probability theory and also examines the relationships between martingales and processes embeddable in or approximated by Brownian motion The text reviews the martingale convergence theorem the classical limit theory and analogs and the martingale limit theorems viewed as the rate of convergence results in the martingale convergence theorem The book explains the square function inequalities weak law of large numbers as well as the strong law of large numbers The text discusses the reverse martingales martingale tail sums the invariance principles in the central limit theorem and also the law of the iterated logarithm The book investigates the limit theory for stationary processes via corresponding results for approximating martingales and the estimation of parameters from stochastic processes The text can be profitably used as a reference for mathematicians advanced students and professors of higher mathematics or statistics

[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.

Stochastic Approximation and Its Application in MCMC

Yichen Cheng, 2013. Stochastic approximation has been widely used since first proposed by Herbert Robbins and Sutton Monro in 1951. It is an iterative stochastic method that attempts to find the zeros of functions that cannot be computed directly. In this thesis, we used the technique in several different aspects. It was used in the analysis of large geostatistical data, in the improvement of simulated annealing algorithm, also as well as for NMR protein structure determination. 1. We proposed a resampling-based Stochastic approximation method for the analysis of large geostatistical data. The main difficulty that lies in the analysis of geostatistical data is the computation time is extremely long when the sample size becomes large. Our proposed method only uses a small portion of the data at each iteration. Each time we update our estimators based on a randomly selected subset of the data using stochastic approximation. In this way, we use the information from the whole data set while keep the computation time almost irrelevant to the sample size. We proved the consistency of our estimator and showed by simulation study that the computation time is much reduced compared to other existing methods. 2. Simulated Annealing algorithm has been widely used for optimization problems. However, it cannot guarantee the global optima to be located unless a logarithmic cooling schedule is used. However, the logarithm rate is so slow that no one can afford such a long CPU time. We proposed a new stochastic optimization algorithm, the so-called simulated stochastic approximation annealing (SAA) algorithm, which is a combination of simulated annealing and the stochastic approximation Monte Carlo (SAMC) algorithm. It is shown that the new algorithm can work with a cooling schedule that decreases much faster than in the logarithmic cooling schedule while guarantee the global optima to be reached when temperature tends to zero. 3. Protein Structure determination is a very important topic in computational biology. It aims to determine different conformations for each protein, which helps to understand biological functions such as protein-protein interactions, protein-DNA interactions, and so on. Protein structure determination consists of a series of steps, and peak picking is a very important step. It is the prerequisite for all other steps. Manually picking the peaks is very time-consuming. To automate this process, several methods have been proposed. However, due to the complexity of NMR spectra, the existing method is hard to distinguish false peaks and true peaks perfectly. The main difficulty lies in identifying true peaks with low intensity and overlapping peaks. We propose to model the spectrum as a mixture of bivariate Gaussian densities and used stochastic approximation Monte Carlo (SAMC) method as the computational approach to solve this problem. Essentially, by putting the

peak picking problem into a Bayesian framework we turned it into a model selection problem Because Bayesian method will automatically penalize including too much component into the model our model will distinguish true peaks from noises without pre process of the data The electronic version of this dissertation is accessible from <http://hdl.handle.net/1969/1151016>

Nonlinear Filters Sueo Sugimoto, Masaya Murata, Katsumi Ohnishi, Genshiro Kitagawa, Hisashi Tanizaki, Katsuji Uosaki, Kazufumi Ito, Kiyotugu Takaba, Masaaki Murata, Masaki Yamakita, Sarah A. King, Shinji Ishihara, Tohru Katayama, Yukihiro Kubo, 2020-12-10 This book covers a broad range of filter theories algorithms and numerical examples The representative linear and nonlinear filters such as the Kalman filter the steady state Kalman filter the H infinity filter the extended Kalman filter the Gaussian sum filter the statistically linearized Kalman filter the unscented Kalman filter the Gaussian filter the cubature Kalman filter are first visited Then the non Gaussian filters such as the ensemble Kalman filter and the particle filters based on the sequential Bayesian filter and the sequential importance resampling are described together with their recent advances Moreover the information matrix in the nonlinear filtering the nonlinear smoother based on the Markov Chain Monte Carlo the continuous discrete filters factorized filters and nonlinear filters based on stochastic approximation method are detailed

- 1 Review of the Kalman Filter and Related Filters
- 2 Information Matrix in Nonlinear Filtering
- 3 Extended Kalman Filter and Gaussian Sum Filter
- 4 Statistically Linearized Kalman Filter
- 5 The Unscented Kalman Filter
- 6 General Gaussian Filters and Applications
- 7 The Ensemble Kalman Filter
- 8 Particle Filter
- 9 Nonlinear Smoother with Markov Chain Monte Carlo
- 10 Continuous Discrete Filters
- 11 Factorized Filters
- 12 Nonlinear Filters Based on Stochastic Approximation Method

SIAM Journal on Control and Optimization Society for Industrial and Applied Mathematics, 2005

Mathematical Reviews, 2007

Fifty Years of Fuzzy Logic and its Applications Dan E. Tamir, Naphtali D. Rishe, Abraham Kandel, 2015-05-23 This book presents a comprehensive report on the evolution of Fuzzy Logic since its formulation in Lotfi Zadeh's seminal paper on fuzzy sets published in 1965 In addition it features a stimulating sampling from the broad field of research and development inspired by Zadeh's paper The chapters written by pioneers and prominent scholars in the field show how fuzzy sets have been successfully applied to artificial intelligence control theory inference and reasoning The book also reports on theoretical issues features recent applications of Fuzzy Logic in the fields of neural networks clustering data mining and software testing and highlights an important paradigm shift caused by Fuzzy Logic in the area of uncertainty management Conceived by the editors as an academic celebration of the fifty years anniversary of the 1965 paper this work is a must have for students and researchers willing to get an inspiring picture of the potentialities limitations achievements and accomplishments of Fuzzy Logic based systems

U.S. Government Research & Development Reports, 1970

Large Sample Methods in Statistics (1994) Pranab K. Sen, Julio M. Singer, 2017-11-22 This text bridges the gap between sound theoretical developments and practical fruitful methodology by providing solid justification for standard asymptotic statistical methods It contains a unified survey of standard large sample theory and

provides access to more complex statistical models that arise in diverse practical applications **Comprehensive Dissertation Index** ,1984 **Handbook of Simulation Optimization** Michael C Fu,2014-11-13 The Handbook of Simulation Optimization presents an overview of the state of the art of simulation optimization providing a survey of the most well established approaches for optimizing stochastic simulation models and a sampling of recent research advances in theory and methodology Leading contributors cover such topics as discrete optimization via simulation ranking and selection efficient simulation budget allocation random search methods response surface methodology stochastic gradient estimation stochastic approximation sample average approximation stochastic constraints variance reduction techniques model based stochastic search methods and Markov decision processes This single volume should serve as a reference for those already in the field and as a means for those new to the field for understanding and applying the main approaches The intended audience includes researchers practitioners and graduate students in the business engineering fields of operations research management science operations management and stochastic control as well as in economics finance and computer science

Stochastic Approximation Algorithms and Applications ,1997 There is a thorough treatment of rate of convergence iterate averaging high dimensional problems ergodic cost problems stability methods for correlated noise and decentralized and asynchronous algorithms *Stochastic Approximation* M. T. Wasan,2004-06-03 A rigorous mathematical treatment of the technique for studying the properties of an experimental situation

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