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Order, Disorder And Criticality - Advanced Problems Of Phase Transition Theory - Complexity, Criticality and Computation (C^3)
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Simulation and the Monte Carlo Method
Monte Carlo Simulations of the Ising Model
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Calculation of Interface Tension and Stiffness in a Two Dimensional Ising Model by Monte Carlo Simulation

Study of Two Dimensional Ising Model by Monte Carlo Simulation
Liquid Crystals and Their Computer Simulations
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BEST CANTRELL

Transition Matrix Monte Carlo Methods for Complex Systems
Springer Science & Business Media
This work is a needed reference for widely used techniques and methods of computer simulation in physics and other disciplines, such as materials science. The work conveys both: the theoretical foundations of computer simulation as well as applications and "tricks of the trade", that often are scattered across various papers. Thus it will meet a need and fill a gap for every scientist who needs computer simulations for his/her task at hand. In addition to being a reference, case studies and exercises for use as course reading are included.
Computational Modeling and Visualization of Physical Systems with

Python Walter de Gruyter Computational Modeling, by Jay Wang introduces computational modeling and visualization of physical systems that are commonly found in physics and related areas. The authors begin with a framework that integrates model building, algorithm development, and data visualization for problem solving via scientific computing. Through carefully selected problems, methods, and projects, the reader is guided to learning and discovery by actively doing rather than just knowing physics. Models of Neural Networks World Scientific The aim of this thesis is to develop efficient transition matrix Monte Carlo simulation methods for complex systems(e.g., spin glasses) that enable one to construct the transition matrix from which the density of states is calculated with high accuracy. In this thesis, I explore a series of the transition matrix Monte Carlo techniques that are newly developed to generate the density of states with high accuracy for various systems that exhibit phase transitions. The Ising model and the Potts model are used to demonstrate the performance of each methods. Especially, the specific heat curve of the two-dimensional Ising model is evaluated and compared to the exact result as a stringent accuracy test in many cases. I extend the \emph{monovariate} multicanonical transition matrix Monte Carlo method to a \emph{bivariate} version

for the calculation of the joint density of states which depends on the energy and a second variable associated with the order parameter. This bivariate version is applied to the Edward-Anderson spin glass model which is one of the most challenging model in the field of computer simulation. After presenting the theoretical basis of the transition matrix Monte Carlo method, I explain the regulated temperature method which populates the transition matrix by the Metropolis algorithm with continuously varying temperature according to a certain schedule. I introduce new techniques that can produce the optimized temperature schedule in the context of the two-dimensional Ising model. Next I proceed to present the multicanonical transition matrix Monte Carlo method in which the transition matrix is constructed through the multicanonical iteration procedure. Although this method itself is faster than other existing techniques such as the broad histogram method and Wang-Landau algorithm, its simulation speed can be further increased by the renormalization idea which utilizes the simulation results for a small system to obtain an accurate initial estimate of the density of states for a large system through the convolution procedures. Especially a novel procedure about how to apply the renormalization idea in multiple dimensions is presented. To study the

critical behavior of the spin glasses, to my knowledge for the first time, I employ the \emph{bivariate} multicanonical sampling to construct the transition tensor from which the joint density of states can be calculated with high accuracy. I introduce a calculation technique that transforms the massive transition tensor to a normal transition matrix to avoid the cumbersome manipulation of tensors. Using the joint density of states, Landau free energies, the probability distribution functions of spin overlap and Binder parameters are calculated. Contrary to the majority of the previous reports in the literature, the results of my method provide evidences that nonzero temperature phase transition occurs in the two-dimensional Ising spin glass. For the $\pm J$ Ising spin glass, the critical temperature obtained by my method is $T_c/J \approx 0.45$ However, a definite conclusion can not be made due to small systems sizes and the limitted number of samples of random couplings.

Computer Simulation Studies in Condensed-Matter Physics VIII

Springer

In Nucleation in Condensed Matter, key theoretical models for nucleation are developed and experimental data are used to discuss their range of validity. A central aim of this book is to enable the reader, when faced with a phenomenon in which nucleation appears to play a role, to

determine whether nucleation is indeed important and to develop a quantitative and predictive description of the nucleation behavior. The third section of the book examines nucleation processes in practical situations, ranging from solid state precipitation to nucleation in biological systems to nucleation in food and drink. Nucleation in Condensed Matter is a key reference for an advanced materials course in phase transformations. It is also an essential reference for researchers in the field. Unified treatment of key theories, experimental evaluations and case studies Complete derivation of key models Detailed discussion of experimental measurements Examples of nucleation in diverse systems

Computational Science and Its Applications - ICCSA 2006 Monte Carlo Simulations of the Ising Model

When leaming very formal material one comes to a stage where one thinks one has understood the material. Confronted with a "reallife" problem, the passivity of this understanding sometimes becomes painfully elear. To be able to solve the problem, ideas, methods, etc. need to be ready at hand. They must be mastered (become active knowledge) in order to employ them successfully. Starting from this idea, the leitmotif, or aim, of this book has been to elose this gap as much as possible. How can this be done? The material presented here was born out of a series of lectures

at the Summer School held at Figueira da Foz (Portugal) in 1987. The series of lectures was split into two concurrent parts. In one part the "formal material" was presented. Since the background of those attending varied widely, the presentation of the formal material was kept as pedagogic as possible. In the formal part the general ideas behind the Monte Carlo method were developed. The Monte Carlo method has now found widespread appli cation in many branches of science such as physics, chemistry, and biology. Because of this, the scope of the lectures had to be narrowed down. We could not give a complete account and restricted the treatment to the ap plication of the Monte Carlo method to the physics of phase transitions. Here particular emphasis is placed on finite-size effects.
Computer Simulation Studies in Condensed-Matter Physics V Springer Science & Business Media
Instead of presenting the standard theoretical treatments that underlie the various numerical methods used by scientists and engineers, Using R for Numerical Analysis in Science and Engineering shows how to use R and its add-on packages to obtain numerical solutions to the complex mathematical problems commonly faced by scientists and engineers. This practical guide to the capabilities of R demonstrates Monte Carlo, stochastic, deterministic, and other numerical methods

through an abundance of worked examples and code, covering the solution of systems of linear algebraic equations and nonlinear equations as well as ordinary differential equations and partial differential equations. It not only shows how to use R's powerful graphic tools to construct the types of plots most useful in scientific and engineering work, but also: Explains how to statistically analyze and fit data to linear and nonlinear models Explores numerical differentiation, integration, and optimization Describes how to find eigenvalues and eigenfunctions Discusses interpolation and curve fitting Considers the analysis of time series Using R for Numerical Analysis in Science and Engineering provides a solid introduction to the most useful numerical methods for scientific and engineering data analysis using R.

The Two-Dimensional Ising Model Springer Science & Business Media

This book provides an introduction to Monte Carlo simulations in classical statistical physics and is aimed both at students beginning work in the field and at more experienced researchers who wish to learn more about Monte Carlo methods. The material covered includes methods for both equilibrium and out of equilibrium systems, and common algorithms like the Metropolis and heat-bath algorithms are discussed in detail, as well as more sophisticated

ones such as continuous time Monte Carlo, cluster algorithms, multigrid methods, entropic sampling and simulated tempering. Data analysis techniques are also explained starting with straightforward measurement and error-estimation techniques and progressing to topics such as the single and multiple histogram methods and finite size scaling. The last few chapters of the book are devoted to implementation issues, including discussions of such topics as lattice representations, efficient implementation of data structures, multispin coding, parallelization of Monte Carlo algorithms, and random number generation. At the end of the book the authors give a number of example programmes demonstrating the applications of these techniques to a variety of well-known models.

Programming in Parallel with CUDA Programming in Parallel with CUDA

Princeton University Press

Computer Simulation Studies in Condensed-Matter Physics VIII covers recent developments in this field presented at the 1995 workshop, such as new algorithms, methods of analysis, and conceptual developments. This volume is composed of three parts. The first part contains invited papers that deal with simulational studies of classical systems. The second part is devoted to invited papers on quantum systems, including new results for strongly correlated electron and quantum spin models. The final part

comprises contributed presentations.
Computer Simulation of a Two Dimensional Ising Model World Scientific
This book teaches modern Markov chain Monte Carlo (MC) simulation techniques step by step. The material should be accessible to advanced undergraduate students and is suitable for a course. It ranges from elementary statistics concepts (the theory behind MC simulations), through conventional Metropolis and heat bath algorithms, autocorrelations and the analysis of the performance of MC algorithms, to advanced topics including the multicanonical approach, cluster algorithms and parallel computing. Therefore, it is also of interest to researchers in the field. The book relates the theory directly to Web-based computer code. This allows readers to get quickly started with their own simulations and to verify many numerical examples easily. The present code is in Fortran 77, for which compilers are freely available. The principles taught are important for users of other programming languages, like C or C++.
Monte Carlo Methods in Statistical Physics Springer Science & Business Media
A new and updated edition of the successful Statistical Mechanics: Entropy, Order Parameters and Complexity from 2006. Statistical mechanics is a core topic in modern physics. Innovative, fresh introduction to the broad range of topics of

statistical mechanics today, by brilliant teacher and renowned researcher.

Statistical Mechanics: Entropy, Order Parameters, and Complexity MDPI

The five-volume set LNCS 3980-3984 constitutes the refereed proceedings of the International Conference on Computational Science and Its Applications, ICCSA 2006. The volumes present a total of 664 papers organized according to the five major conference themes: computational methods, algorithms and applications high performance technical computing and networks advanced and emerging applications geometric modelling, graphics and visualization information systems and information technologies. This is Part V.

Unphysical Frozen States in Monte Carlo Simulation of 2D Ising Model John Wiley & Sons

Cellular automata make up a class of completely discrete dynamical systems, which have became a core subject in the sciences of complexity due to their conceptual simplicity, easiness of implementation for computer simulation, and their ability to exhibit a wide variety of amazingly complex behavior. The feature of simplicity behind complexity of cellular automata has attracted the researchers' attention from a wide range of divergent fields of study of science, which extend from the exact disciplines of mathematical physics up to the social ones, and beyond. Numerous

complex systems containing many discrete elements with local interactions have been and are being conveniently modelled as cellular automata. In this book, the versatility of cellular automata as models for a wide diversity of complex systems is underlined through the study of a number of outstanding problems using these innovative techniques for modelling and simulation. **Physics Briefs** Elsevier Studies of surfaces and interactions between dissimilar materials or phases are vital for modern technological applications. Computer simulation methods are indispensable in such studies and this book contains a substantial body of knowledge about simulation methods as well as the theoretical background for performing computer experiments and analyzing the data. The book is self-contained, covering a range of topics from classical statistical mechanics to a variety of simulation techniques, including molecular dynamics, Langevin dynamics and Monte Carlo methods. A number of physical systems are considered, including fluids, magnets, polymers, granular media, and driven diffusive systems. The computer simulation methods considered include both standard and accelerated versions. The simulation methods are clearly related to the fundamental principles of thermodynamics and statistical mechanics. Computational Science — ICCS 2001 Springer

Science & Business Media This book is the fifth volume of papers on advanced problems of phase transitions and critical phenomena, the first four volumes appeared in 2004, 2007, 2012, and 2015. It aims to compile reviews in those aspects of criticality and related subjects that are of current interest. The seven chapters discuss criticality of complex systems, where the new, emergent properties appear via collective behaviour of simple elements. Since all complex systems involve cooperative behaviour between many interconnected components, the field of phase transitions and critical phenomena provides a very natural conceptual and methodological framework for their study. As the first four volumes, this book is based on the review lectures that were given in Lviv (Ukraine) at the "Ising lectures" — a traditional annual workshop on phase transitions and critical phenomena which aims to bring together scientists working in the field of phase transitions with university students and those who are interested in the subject. Contents: Statistical Properties of One-Dimensional Directed Polymers in a Random Potential (V Dotsenko)Non-Euclidean Geometry in Nature (S Nechaev)Dynamics of Polymers: Classic Results and Recent Developments (M V Tamm and K Polovnikov)Generalized Ensemble Computer Simulations of Macromolecules (W

Janke)Photo-Controllable Networks in Macromolecular Solutions and Blends (J M Ilnytskyi)Monte Carlo Methods for Massively Parallel Computers (M Weigel)Complex Networks and Infrastructural Grids (A Scala) Readership: Advanced undergraduates and graduate students, researchers and scientists interested in phase transitions and critical phenomena. Keywords: Phase Transitions;Criticality;Scaling;Complex SystemsReview:0

Rugged Free Energy Landscapes BoD – Books on Demand

This book series in the rapidly growing field of computational physics offers up-to-date (submitted to the publisher by electronic mail) reviews for the researcher. The first volume, written by authors from four continents, emphasizes statistical physics. For example, Ising problems are reviewed where theoretical approaches led to contradictory approaches and only quality computing answered who is right. In addition, fields as diverse as neural networks, granular materials, and computer algebra are reviewed. The next volume on percolation and other fields is already in preparation. Contents:Computational Aspects of Damage Spreading (N Jan & L de Arcangelis)Monte Carlo Simulations of Dilute Ising Models (W Selke et al.)Interfacial Dynamics in Disordered Magnets: Relaxation, Critical Dynamics, and Domain

Growth (D Chowdhury & B Biswal)Ising System in Oscillating Field: Hysteretic Response (M Acharyya & B K Chakrabarti)Recent Results on the Decay of Metastable Phases (P A Rikvold & B M Gorman)Multineuron Interaction Effects (R M C de Almeida et al.)Random and Self-Avoiding Walks in Disordered Media (H Nakanishi)Granular Dynamics: A Review About Recent Molecular Dynamics Simulations of Granular Materials (G H Ristow)Symbolic–Numeric Interfaces (M C Dewar) Readership: Computational physicists, theoretical physicists and statistical physicists. keywords:Nucleation;Interface;Damage Spreading;Neural Nets Solid State PhysicsMetastable, Spintronics Materials and Mechanics of Deformable Bodies Springer Science & Business Media Standing as the first unified textbook on the subject, Liquid Crystals and Their Computer Simulations provides a comprehensive and up-to-date treatment of liquid crystals and of their Monte Carlo and molecular dynamics computer simulations. Liquid crystals have a complex physical nature, and, therefore, computer simulations are a key element of research in this field. This modern text develops a uniform formalism for addressing various spectroscopic techniques and other experimental methods for studying phase transitions of liquid crystals, and emphasises the links between their molecular

organisation and observable static and dynamic properties. Aided by the inclusion of a set of Appendices containing detailed mathematical background and derivations, this book is accessible to a broad and multidisciplinary audience. Primarily intended for graduate students and academic researchers, it is also an invaluable reference for industrial researchers working on the development of liquid crystal display technology.

Phase Changes in the Ising Model World Scientific
This book is a printed edition of the Special Issue "Complexity, Criticality and Computation (C^3)" that was published in Entropy
Markov Chain Monte Carlo Simulations and Their Statistical Analysis John Wiley & Sons
As the role of computer simulations began to increase in importance, we sensed a need for a "meeting place" for both experienced simulators and neophytes to discuss new techniques and results in an evironment which promotes extended discussion. As a consequence of these concerns, The Center for Simulational Physics established an annual workshop on Recent Developments in Computer Simulation Studies in Condensed-Matter Physics. This year's workshop was the fifth in this series and the interest which the scientific community has shown demonstrates quite clearly the useful purpose which the series has

served. The workshop was held at the University of Georgia, February 17-21, 1992, and these proceedings form a record of the workshop which is published with the goal of timely dissemination of the papers to a wider audience. The proceedings are divided into four parts. The first part contains invited papers which deal with simulational studies of classical systems and includes an introduction to some new simulation techniques and special purpose computers as well. A separate section of the proceedings is devoted to invited papers on quantum systems including new results for strongly correlated electron and quan tum spin models. The third section is comprised of a single, invited description of a newly developed software shell designed for running parallel programs. The contributed presentations comprise the final chapter.

Computational Physics

Oxford University Press, USA

CUDA is now the dominant language used for programming GPUs, one of the most exciting hardware developments of recent decades. With CUDA, you can use a desktop PC for work that would have previously required a large cluster of PCs or access to a HPC facility. As a result, CUDA is increasingly important in scientific and technical computing across the whole STEM community, from medical physics and financial modelling to big data applications and beyond. This unique book

on CUDA draws on the author's passion for and long experience of developing and using computers to acquire and analyse scientific data. The result is an innovative text featuring a much richer set of examples than found in any other comparable book on GPU computing. Much attention has been paid to the C++ coding style, which is compact, elegant and efficient. A code base of examples and supporting material is available online, which readers can build on for their own projects.

The Validity of Classical Nucleation Theory and Its Application to Dislocation Nucleation Springer Science & Business Media

This book teaches modern Markov chain Monte Carlo (MC) simulation techniques step by step. The material should be accessible to advanced undergraduate students and is suitable for a course. It ranges from elementary statistics concepts (the theory behind MC simulations), through conventional Metropolis and heat bath algorithms, autocorrelations and the analysis of the performance of MC algorithms, to advanced topics including the multicanonical approach, cluster algorithms and parallel computing. Therefore, it is also of interest to researchers in the field. The book relates the theory directly to Web-based computer code. This allows readers to get quickly started with their own simulations and to verify many numerical examples easily. The present code is in Fortran

77, for which compilers are freely available. The principles taught are important for users of other programming languages, like C or C++.