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Monte Carlo Modeling for Electron Microscopy and ...

The Monte Carlo method for electron transport is a semiclassical Monte Carlo approach of modeling semiconductor transport. Assuming the carrier motion consists of free flights interrupted by scattering mechanisms, a computer is utilized to simulate the trajectories of particles as they move across the device under the influence of an electric field using classical mechanics. The scattering events and the duration of particle flight is determined through the use of random numbers.

Monte Carlo methods for electron transport - Wikipedia

Elekta - CMS XiO Monte Carlo system • XiO eMC module is based on the early VMC* code – simulates electron (or photon) transport through voxelized media • The beam model and electron air scatter functions were developed by CMS • The user can specify – voxel size – dose-to-medium or dose-to-water – random seed

Monte Carlo treatment planning for electron beams

Monte Carlo simulation methods for the study of electron beam interaction with solids have been mostly concerned with specimens of simple geometry. In this article, we propose a simulation algorithm for treating arbitrary complex structures in a real sample.

Monte Carlo simulation of secondary electron images for ...

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[MONTE CARLO MODELING FOR ELECTRON MICROSCOPY AND ...

A systematic study has been performed based on a Monte Carlo simulation for the investigation of secondary electron yields, backscattering coefficients, and total electron yields for eight compound...

Monte Carlo simulation study of electron yields from ...

Thus far, Monte Carlo electron beam simulations have been described either as typical electron optics simulations (i.e. collision free in vacuum), or exclusively in solids - or gases (plasmas) - with emphasis on the electron matter interaction.

Monte Carlo simulations of 1keV to 100keV electron ...

The origins of Quantum Monte Carlo methods are often attributed to Enrico Fermi and Robert Richtmyer who developed in 1948 a mean field particle

interpretation of neutron-chain reactions, but the first heuristic-like and genetic type particle algorithm (a.k.a. Resampled or Reconfiguration Monte Carlo methods) for estimating ground state energies of quantum systems (in reduced matrix models) is ...

Monte Carlo method - Wikipedia

Electron Beam Scattering Modeling. Professor R. Gauvin has spent several years working on the development of new methods to characterize the microstructure of complex materials using electron microscopy with X-Ray microanalysis. The original approach of Professor Gauvin research is to develop Monte Carlo programs to simulate electron scattering in materials in order to correlate X-Ray emission to composition in quantitative X-Ray microanalysis.

Electron Beam Scattering Modeling

Buy [Monte Carlo Modeling for Electron Microscopy and Microanalysis] (By: D.C. Joy) [published: April, 1995] by D.C. Joy (ISBN:) from Amazon's Book Store. Everyday low prices and free delivery on eligible orders.

[Monte Carlo Modeling for Electron Microscopy and ...

The CASINO acronym has been derived from the words "monte CArlo SImulation of electroN trajectory in sOlids". This program is a Monte Carlo simulation of electron trajectory in solid specially designed for low beam interaction in a bulk and thin foil. This complex single scattering Monte Carlo program is specifically designed for low energy beam interaction and can be used to generate many of the recorded signals (X-rays and backscattered electrons) in a scanning electron microscope.

Casino - usherbrooke.ca

A Monte Carlo model has been developed to study the degradation of ?1000 eV electrons in an atmosphere of CO2, which is one of the most abundant species in Mars' and Venus's atmospheres. The e?CO2...

Monte Carlo model of electron energy degradation in a CO2 ...

Computer programs for two basic types of Monte Carlo simulation are developed from physical models of the electron scattering process--a single scattering program capable of high accuracy but requiring long computation times, and a plural scatter

Monte Carlo Modeling for Electron Microscopy and ...

The electron trajectories are simulated by using a Monte Carlo (or random sampling) method. Each electron enters the solid with a given energy, and its trajectory is followed until it comes to rest or exits the sample. To simulate a beam, the process is repeated for a large number of electrons.

EISS - Electron beam Monte Carlo simulator

A free software package for Monte Carlo simulation of electron trajectories in solids. Available in Lehigh Microscopy School DVD. Author: David Joy. Platform: Windows. Citation: D.C. Joy, Monte Carlo Modeling for Electron Microscopy and Microanalysis, Oxford University Press, (ISBN: 0195088743),

1995. Link: http://web.utk.edu/~srcutk/htm/simulati.htm.

Masashi Watanabe's Home Page - Profile: General

A Monte Carlo code has been developed to model the interaction of an electron beam with one or two lines lithographically produced on a multilayer substrate. The purpose of the code is to enable one to extract the edge position of a line from SEM measurements.

Use of Monte Carlo modeling for interpreting scanning ...

Dose calculation plays an important role in the accuracy of radiotherapy treatment planning and beam delivery. The Monte Carlo (MC) method is capable of achieving the highest accuracy in radiotherapy dose calculation and has been implemented in many commercial systems for radiotherapy treatment planning.

This book describes for the first time how Monte Carlo modeling methods can be applied to electron microscopy and microanalysis. Students and professionals using electron microscopes will want to read this important addition to the literature.

This work establishes a framework for Monte Carlo simulations of complex, modulated electron fields produced by Varian's TrueBeam medical linear accelerator for investigations into modulated electron radiation therapy (MERT) and combined modulated photon and electron radiation therapy (MPERT). Both MERT and MPERT have shown potential for reduced low dose to normal tissue without compromising target coverage in the external beam radiation therapy of some breast, chest wall, head and neck, and scalp cancers. This reduction in low dose could translate into the reduction of immediate radiation side effects as well as long term morbidities and incidence of secondary cancers.Monte Carlo dose calculations are widely accepted as the gold standard for complex radiation therapy dose modelling, and are used almost exclusively for modelling the complex electron fields involved in MERT and MPERT. The introduction of Varian's newest linear accelerator, the TrueBeam, necessitated the development of new Monte Carlo models in order to further research into the potential role of MERT and MPERT in radiation therapy. This was complicated by the fact that the field independent internal schematics of TrueBeam were kept proprietary, unlike in previous generations of Varian accelerators.Two approaches are presented for performing Monte Carlo simulations of complex electron fields produced by TrueBeam. In the first approach, the dosimetric characteristics of electron fields produced by the TrueBeam were first compared with those produced by an older Varian accelerator, the Clinac 21EX. Differences in depth and profile characteristics of fields produced by the TrueBeam and those produced by the Clianc 21EX were found to be within 3%/3 mm. Given this information, complete accelerator models of the Clinac 21EX, based on its known internal geometry, were then successfully modified in order to simulate 12 and 20 MeV electron fields produced by the TrueBeam to within 2%/2 mm of measured depth and profile curves and to within 3.7% of measured relative output. While the 6 MeV TrueBeam model agreed with measured depth and profile data to within 3%/3 mm, the modified Clinac 21EX model was unable to reproduce trends in relative output as a function of fieldsize with acceptable accuracy.The second approach to modelling TrueBeam electron fields used phase-space source files provided by Varian that were scored below the field-independent portions of the accelerator head geometry. These phase-spaces were first validated for use in MERT and MPERT applications, in which simulations using the phase-space source files were shown to model depth dose curves that agreed with measurement

within 2%/2 mm and profile curves that agreed with measurement within 3%/3 mm. Simulated changes in output as a function of field size fell within 2.7%, for the most part.In order to inform the positioning of jaws in MLC-shaped electron field delivery, the change in output as a function of jaw position for fixed MLC-apertures was investigated using the phase-space source files. In order to achieve maximum output and minimize treatment time, a jaw setting between 5 and 10 cm beyond the MLC- field setting is recommended at 6 MeV, while 5 cm or closer is recommended for 12 and 20 MeV with the caveat that output is most sensitive to jaw position when the jaws are very close to the MLC-field periphery. Additionally, output was found to be highly sensitive to jaw model. A change in divergence of the jaw faces from a point on the source plane to a 3x3 mm^2 square in the source plane changed the shape of the output curve dramatically.Finally, electron backscatter from the jaws into the monitor ionization chamber of the TrueBeam was measured and simulated to enable accurate absolute dose calculations. Two approaches were presented for measuring backscatter into the monitor ionization chamber without specialized electronics by turning o the dose and pulse forming network servos. Next, a technique was applied for simulating backscatter factors for the TrueBeam phase-space source models without the exact specifications of the monitor ionization chamber. By using measured backscatter factors, the forwarddose component in a virtual chamber was determined and then used to calculate backscatter factors for arbitrary fields to within 0.21%. Backscatter from the jaws was found to contribute up to 2.6% of the overall monitor chamber signal. The measurement techniques employed were not sensitive enough to quantify backscatter from the MLC, however, Monte Carlo simulations predicted this contribution to be 0.3%, at most, verifying that this component can be neglected.

X-ray microanalysis by analytical electron microscopy (AEM) has proven to be a powerful tool for characterizing the spatial distribution of solute elements in materials. True compositional variations over spatial scales smaller than the actual resolution for microanalysis can be determined if the measured composition profile is deconvoluted. Explicit deconvolutions of such data, via conventional techniques such as Fourier transforms, are not possible due to statistical noise in AEM microanalytical data. Hence, the method of choice is to accomplish the deconvolution via iterative convolutions. In this method, a function describing the assumed true composition profile, calculated by physically permissible thermodynamic and kinetic modeling, is convoluted with the x-ray generation function and the result compared to the measured composition profile. If the measured and calculated profiles agree within experimental error, it is assumed that the true compositional profile has been determined. If the measured and calculated composition profiles are in disagreement, the assumptions in the physical model are adjusted and the convolution process repeated. To employ this procedure it is necessary to calculate the x-ray generation function explicitly. While a variety of procedures are available for calculating this function, the most accurate procedure is to use Monte Carlo modeling of electron scattering.

Monte Carlo method is an invaluable tool in the field of radiation protection, used to calculate shielding effectiveness, as well as dose for medical applications. With few exceptions, most of the objects currently simulated have been homogeneous materials that vary in density by a factor of 3 or less. In the irradiation of very heterogeneous objects, particularly layered or leafy food items, one will encounter air pockets within the bundle as a matter of course. These pockets will cause variations in density of up to three orders of magnitude. Air pockets in a tissue equivalent phantom were found to produce "hot spots" in the dose distribution, and introduced significant deviations between the calculated and measured distribution of dose to the phantom. To date, very little published work had been done in the area of Monte-Carlo simulation of objects of such disparate density. Before Monte Carlo methods can be used

successfully in this regime, further code development and experimental validation will be necessary, of which this work is just a beginning. Phantoms were made of corrugated low-Z material similar in electron density to plant based material. These phantoms incorporated air gaps of comparable size to those found in the leafy objects of interest. Dimensions were chosen to bracket electron ranges in the material of the objects modeled. Monte Carlo analysis will provide a reasonable qualitative picture of the dose distribution, but such a picture is not yet sufficiently accurate in a quantitative sense. Air gaps within the plant material produced large discrepancies between calculation and measurement. Smaller air gaps were observed to produce greater discrepancy between calculation and measurement.

Monte Carlo simulation is now a well established method for studying semiconductor devices and is particularly well suited to highlighting physical mechanisms and exploring material properties. Not surprisingly, the more completely the material properties are built into the simulation, up to and including the use of a full band structure, the more powerful is the method. Indeed, it is now becoming increasingly clear that phenomena such as reliabil ity related hot-electron effects in MOSFETs cannot be understood satisfac torily without using full band Monte Carlo. The IBM simulator DAMOCLES, therefore, represents a landmark of great significance. DAMOCLES sums up the total of Monte Carlo device modeling experience of the past, and reaches with its capabilities and opportunities into the distant future. This book, therefore, begins with a description of the IBM simulator. The second chapter gives an advanced introduction to the physical basis for Monte Carlo simulations and an outlook on why complex effects such as collisional broadening and intracollisional field effects can be important and how they can be included in the simulations. References to more basic intro the book. The third chapter ductory material can be found throughout describes a typical relationship of Monte Carlo simulations to experimental data and indicates a major difficulty, the vast number of deformation poten tials required to simulate transport throughout the entire Brillouin zone. The fourth chapter addresses possible further extensions of the Monte Carlo approach and subtleties of the electron-electron interaction.

A Response Matrix Monte Carlo (RMMC) method has been developed for solving electron transport problems. This method was born of the need to have a reliable, computationally efficient transport method for low energy electrons (below a few hundred keV) in all materials. Today, condensed history methods are used which reduce the computation time by modeling the combined effect of many collisions but fail at low energy because of the assumptions required to characterize the electron scattering. Analog Monte Carlo simulations are prohibitively expensive since electrons undergo coulombic scattering with little state change after a collision. The RMMC method attempts to combine the accuracy of an analog Monte Carlo simulation with the speed of the condensed history methods. Like condensed history, the RMMC method uses probability distributions functions (PDFs) to describe the energy and direction of the electron after several collisions. However, unlike the condensed history method the PDFs are based on an analog Monte Carlo simulation over a small region. Condensed history theories require assumptions about the electron scattering to derive the PDFs for direction and energy. Thus the RMMC method samples from PDFs which more accurately represent the electron random walk. Results show good agreement between the RMMC method and analog

Monte Carlo. 13 refs., 8 figs.