
Preface

Monte Carlo methods have become an important tool for exploring complicated systems and especially for investigation of imaging parameters in nuclear medicine. By using sampling methods based on probability distribution function in combination with methods that simulate the various particle interaction that can occur, a detailed radiation transport can be simulated from the patient into the imaging system. Monte Carlo simulation does not replace experimental measurements but offers a unique possibility to gain understanding in the underlying physics phenomena that form nuclear medicine images. It also provides a substantial help to researchers to develop methods for image improvement. When combining an accurate model of the imaging system and a realistic model of the patient's geometry and activity distribution, the simulated images can be highly clinically realistic and almost undistinguishable from a real patient measurement.

The first edition of this book was published in 1998. It was one of the first books that combined a description of the Monte Carlo methods and principles with relevant Monte Carlo programs and applications in the field of diagnostic nuclear medicine. It is now 14 years since that publication and we therefore felt that it was important to have a second edition since new and very powerful Monte Carlo programs and methods have become available.

This new edition provides the background to, and a summary of, the current Monte Carlo techniques that are in use today. The focus is still on the diagnostic imaging application but several programs that are described in the book also allow for charge-particle simulations applicable to dosimetry-related applications. The physics and technology behind scintillation camera imaging, SPECT/PET systems, and several MC simulation programs are described in detail. We have retained the aim from the first edition of the book, that is, to explain the Monte Carlo method and introduce the reader to some Monte Carlo software packages, developed and used by different research groups, and to give the reader a detailed idea of some possible applications of Monte Carlo in current research in SPECT and PET. Some of the chapters in the first edition of the book have been omitted to allow space for coverage of new programs and topics. Other chapters have been retained but updated. This does not mean that the chapters that we were not been able to include are unimportant; so thus a good suggestion is to have access to both editions.

Some chapters in this book describe in detail the physics and technology behind current simulated imaging detectors and systems in nuclear medicine and molecular imaging. The reason behind this is to let the reader be familiar with the imaging systems and to provide an understanding of the complexity of the systems that Monte Carlo programs are intended to simulate.

The text is intended to be useful both for education on graduate and undergraduate levels, and as a reference book on the Monte Carlo method in diagnostic nuclear medicine.