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Book review

Hendee's Physics of Medical Imaging, 5th Edition, Authors: Ehsan Samei, Donald J. Peck; preceded by William R. Hendee, Medical Imaging Physics, published by John Wiley & Sons, Inc., Hoboken, NJ 07030, USA. First published 2019, 468 pages, XXII, 437 figures (most of them in color), ISBN: 9780470552209 (hardcover).

1. Description

The book "Hendee's Physics of Medical Imaging" originates from the decision of making an updated version of the successful text "Medical Imaging Physics", 3rd Edition, by William R. Hendee and Russell Ritenour as authors. Ehsan Samei and Donald Peck took the responsibility of making the revision. During the project the book took its life on its own and its name was changed to "Hendee's Physics of Medical Imaging", alas maintaining the 5th edition tag to keep its connection with the original William R. Hendee's book. Indeed, this book is a celebration of Medical Imaging as an interdisciplinary field, where the fundamentals of the radiation interaction with matter are connected with the biological and medical disciplines within the frame of *Imaging Science*. All the major medical imaging techniques are described in depth as optimized tools for each clinical purpose. A total of 437 figures and numerous tables accompany the 468 pages of the book: all the illustrations are accurately selected to support the text so as to be fully understood by the reader. The book consists of 11 sections (one introduction and 10 chapters). As in the original text, no numerical examples are interspaced within the text and no problems are presented. The chosen approach is that of a teaching book with a descriptive nature that always discusses the principles behind the various imaging techniques and the rationale for their application in medicine.

2. Purpose

The book can be used not only as a complete textbook for graduate students in medical physics, at PhD and Specialty School level, but also as an indispensable reference text for medical doctors, who are working in all fields of imaging (radiology, nuclear medicine, cardiology, radiotherapy). Its content is excellent for medical physics candidates who are preparing for certification in medical physics sub-specialty. In general, this book will be very useful to all professionals who are making use of either non-ionizing or ionizing radiation in their practice.

3. Contents and features

The book starts with an introduction that guides the reader to the "Role of Imaging in Medicine" and contains a brief and clear presentation of the various subfields of radiation imaging. Then ten chapters follow, that are robust on their own, but are also tightly interconnected with each other, so as to give the reader an integral overview of the field. The first Chapter is a review of Radiation and Matter. It is a concise but precise nuclear physics introduction that covers both natural radiation and artificial radiation (e.g. X-ray production) and their interaction with matter. The last part of this chapter is devoted to the description of the basic radiation detectors. In chapter 2 the reader is then conducted hand-by-hand through the disciplines of anatomy, physiology and pathology that are of interest for Imaging in Medicine. Many times these topics are not present in medical imaging books or their treatment is too limited. This is not the case in this book. I am convinced that this chapter is essential for medical physicists who want to work successfully in medical imaging, because it gives them the basic knowledge and the proper language to interact and discuss with the medical doctors. Chapter 3 covers "Imaging Science" presented as a sub-discipline *per se* that is applied and extends to all imaging techniques. The efforts by the authors of the book have been devoted to the basic of Imaging formation and analysis, not forgetting the statistics and image processing. This is a field that is rapidly evolving with the advent of Artificial Intelligences (AI) in Medical Imaging and I am sure that next edition of this book will cover at length this topic as well. The following Chapter 4 treats the field of radioprotection of the patient, i.e., radiobiology, dosimetry and protection. The radiation effects at cellular level and at the animal level are very well summarized and provides the reader with a solid preparation on the safe use of radiation in medicine. Medical physicists must be well trained in this field since they often act as an interface between the patient and the medical doctors, and between the medical imaging discipline and the population at large. Chapter 5 covers the topic of operational imaging, both as human vision and medical displays. The topic of display performance and their quality control is becoming more and more relevant. However, it is often only marginally touched in other imaging books. Here the expertise of one of the authors in this field is very evident by the excellent content of the chapter. The remaining five chapters cover the five pillars of the medical imaging techniques and their clinical applications, i.e., Projection X-ray imaging (chapter 6), Volumetric X-ray Imaging (chapter 7), Nuclear medicine (chapter 8), Ultrasonography (chapter 9) and finally Magnetic Resonance Imaging (chapter 10). It should be noted the modern terminology adopted of Volumetric X-ray imaging that properly groups Tomosynthesis and CT, since the first one was the funding technique for the onset of CT. These chapters cover the physical and technical issues without forgetting the clinical applications and the description of the state-of-the-art apparatuses. Chapter 8 on Nuclear Medicine is somehow limited especially for the part referring to PET, but the principles and the fundamental issues are present. The longest chapter of all (more than 100 pages) is that one on magnetic resonance (chapter 10), where the physics of MR imaging is extremely well covered and can be used as a book within a book for learning what is MR imaging. Only touched in this chapter are the hybrid scanners, e.g. PET/MR and SPECT/MR, the clinical use of which is rapidly expanding worldwide. Each chapter has a robust

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bibliography, that allows the reader to elaborate on any argument treated in the book. A well sorted analytical index completes the book.

4. Assessment

This is an accurate and complete textbook and reference book that covers the history, the principles and the state-of-the-art of Medical Imaging. I particularly recommend this book to the physicists and engineers who are involved, or plan to become involved, in this discipline both in research laboratories and in the clinical practice. On the other hand, radiologists, nuclear medicine doctors, cardiologists, neurologists and other clinicians will find this book very useful and handy for any technical/technological problem they need to have clarified.

5. Reviewed by Alberto Del Guerra

Alberto Del Guerra has been Professor of Medical Physics at the University of Napoli (Italy), the University of Ferrara (Italy) and the University of Pisa (Italy), Head and Director of the Medical Physics School of the University of Pisa, Leader of the Functional Imaging and Instrumentation Group of the Department of Physics of the University of Pisa, President of the European Federation of Organizations for Medical Physics (EFOMP), Member of the ADCOM of the IEEE NPSS Society. He is now retired professor at the University of Pisa and Honorary Editor of the Journal Physica Medica, EJMP.

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