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MRI FOR TECHNOLOGISTS

Peggy Woodward and Roger Freimarck, Editors. New York, NY: McGraw Hill, Inc.; 1995; 335 pages; $48.00 US, soft cover; ISBN 0-07-022149-9.

This book aims to cover both the physical principles and clinical practice of magnetic resonance imaging (MRI). The editors do so in a fairly comprehensive manner and in reasonable depth, considering its 335-page scope. As the premier text devoted to technologists, it certainly delivers a long-awaited contribution to the ever-increasing list of MRI textbooks. The book is an "all-encompassing review of MRI," according to its publisher. The level and scope of the text is commensurate with a technologists' educational background. *MRI for Technologists* includes 20 chapters, written by various experts and educators, concerning daily technical practices. A comprehensive glossary and a list of symbols and abbreviations also is included.

The book covers the various topics of MRI in a refreshing style and understandable manner. It starts out, in the first chapter, with an interesting overview of the historic developments in MRI before embarking on the more technical aspects and clinical utility. This chapter provides a good chronology of the evolution of nuclear magnetic resonance in medical imaging. The physics treatment is simple and straight forward. This section introduces the requisite physical concepts of MRI, including instrumentation and pulse sequences. The latter part of the book deals with topics such as MR angiography, breast imaging, contrast agents, safety and patient care. A useful aspect of this book, which is not available in others, is the chapter on fundamentals of image interpretation for technologists. This coverage will be of great help to nuclear medicine technologists who must reorient themselves with MRI's high-resolution region-specific images that are vastly different from the organ-specific scintigraphs.

I highly recommend this book as a starting point for nuclear medicine technologists interested in learning about MRI. Practicing MRI technologists may find this text helpful in preparing for the ARRT MRI certification at a reasonable cost. If complemented with ample exercises and practice problem sets, the book also can be used in focused teaching of the subject to technical students.

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TECHNICAL MAGNETIC RESONANCE IMAGING

John A. Markisz and Michael Aquilia. Stamford, CT: Appleton and Lange; 1996; 287 pages; $39.00 US, soft cover; ISBN 0-8385-8836-0.

According to the authors, Markisz and Aquilia, *Technical Magnetic Resonance Imaging* was written to "provide those directly involved with MRI, technologists and radiologists, with a practical discussion of the technical aspects involved in actually performing MRI." While it successfully fulfills its goal, the book can serve as a well-illustrated and concise introduction to MRI for the beginning nuclear medicine technologist as well. The book contains a prologue and 12 chapters. General topics include magnetism and magnetic properties of matter, images and image quality, magnetic resonance and imaging, instrumentation, pulse sequencing and scanning parameters, special procedures and techniques, biological effects and safety precautions, artifacts, quality control and patient care. In all of these areas, the authors discuss both theoretical and practical information needed for understanding MRI, drawing on a wide base of referenced materials. In general, the explanations are clear and well illustrated, especially in the early physics chapters that deal with material unfamiliar to many technologists.

A unique feature of this book is the well-outlined summary, at the end of each chapter, that the authors call "Points to Ponder." The strength of this book is its ability to introduce the complex aspects of MRI in a simple yet concise manner. It provides well-prepared coverage of the technical aspects of MR and how it relates to image acquisition and formation. Another unique part of this book is its chapter on quality control. This chapter is well written and covers most of the routine tests in an understandable fashion. The high-quality images of the different phantoms used in MRI quality control will prove useful for technologists and other professionals involved with MRI.

This book provides three value-added appendices. The first appendix lists a useful bibliography divided into six sections: principles of MRI, biological effects and safety, quality assurance, image artifacts, patient care and anatomy. The second and third appendices contain a glossary and a list of abbreviations and acronyms, respectively.

This book is useful for technologists who are about to embark on a career in MRI. It covers the different aspects of MRI physics and clinical applications in a clear and practical manner. The experienced reader will find a great deal of useful information, in particular practical hints, such as how to set up a quality control program.

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MRI BASIC PRINCIPLES AND APPLICATIONS

Mark A. Brown and Richard C. Semelka. New York, NY: Wiley-Liss; 1995; 149 pages; $29.95 US, paperback; ISBN 0-471-12825-2.

This book is a brief and concise introduction to the principles and practice of MRI in 13 chapters. The first three chapters introduce the nuclear magnetic resonance phenomenon and the sources of intrinsic contrast in MRI. This section includes well-presented macro- and microscopic illustrations of protons in the presence of an external magnetic field. Chapter 3 introduces the basics of relaxation time constants (T1, T2 and T2*) and a brief discussion of the spin-echo pulse sequence. Chapters 4 through 6, according to the authors, describe the "concepts of spatial localization and various imaging techniques that are commonly used." Topics included

in this section are selective excitation and slice selection, frequency and phase encoding, and data acquisition techniques. An overview of raw data storage/manipulation and various aspects of the digital image also is provided. The k-space treatment in this section, supplemented with a set of figures, is one of the simplest and most accurate tutorials I have read. Chapters 7 through 10 deal with the basics of MRI and MRA techniques, artifacts and motion-artifact reduction techniques. Topics, such as enhancing contrast between tissues and ensuring fidelity of the detected signals, are carefully covered. Chapter 8 is well complemented with sample MR images showing the various artifacts discussed. Poor print quality, however, makes it is rather difficult to visualize the artifacts on the MR images.

MRI instrumentation, including data acquisition systems, is covered in Chapter 11. This chapter concludes with a short summary of the components of the MRI system. Discussion of the magnetic component of the imaging systems is organized on field strength, rather than the conventional classifications of permanent, resistive and superconducting. Although the discussion includes a comparative review of these magnet systems, the authors do not address the specific advantages and disadvantages of each magnet type. Chapters 12 and 13 provide a brief overview of magnetopharmaceuticals in clinical use and sample MRI clinical practices. The chapter on contrast agents does not address safety issues nor clinical utility. Interestingly, the final chapter, dealing with clinical applications, does not include any MR images.

Throughout the text, the authors achieve their objective of introducing complex subject matter by presenting the topics in a reader-friendly fashion. *MRI Basic Principles and Applications* is well presented with ample illustrations. The only limitation of this book is its lack of MRI safety and patient care coverage. A brief chapter addressing these issues would complement the book nicely. Nonetheless, this book will serve as a useful introduction to MRI for nuclear medicine technologists and students.

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NUMERICAL RECIPES IN FORTRAN 90: THE ART OF PARALLEL SCIENTIFIC COMPUTING, 2nd ed., vol. 2 of FORTRAN NUMERICAL RECIPES

William H. Press, Saul A. Teukolsky, William T. Vetterling and Brian P. Flannery. New York, NY: Cambridge University Press; 1996; 551 pages; $44.95 US; ISBN 0-521-57439-0.

This book is the second volume of the popular computational math methods and analysis text *Numerical Recipes in Fortran 90: The Art of Parallel Scientific Computing*. The original text, retroactively labeled Volume 1, is noted for its breadth of topics and informative introductory discussions of the background and theoretical underpinnings of the algorithms presented. Although specialists in particular subfields often are aware of superior algorithms for their specific applications, the algorithms described in *Numerical Recipes in Fortran 90* are remarkably robust, effective and generally easily adapted to a broad range of problems. Topics of interest to the nuclear medicine imaging community include linear algebra, interpolation, numerical integration, random number generators, function minimization, Fourier and spectral analysis, data modeling and inverse methods.

In this new book, the authors have recast all of the algorithms in Volume 1 to take advantage of the extended capability of Fortran 90, particularly the new and powerful array intrinsic functions that lay the groundwork for highly-accelerated performance in parallel-computing environments. They make a convincing case that parallel-processing capability, previously limited exclusively to the most advanced mainframes and supercomputers, is heading for the desktop. Indeed, they predict that a typical desktop computer will have four to eight CPUs within just a few years, and that the number of CPUs per computer will increase rapidly thereafter. They argue that it is time for us to develop software and programming techniques that can take advantage of the great potential increase in computational speed that these systems will offer. *Numerical Recipes in Fortran 90* is an excellent step in this direction.

In addition to increased performance on parallel computers, there are many other advantages of programming in Fortran 90. The array intrinsics alone provide for substantially more compact and readable code. These functions obviate the need for many inelegant, bulky do-loops, and they more naturally reflect the way scientists think about the problems they are solving. Even single-processor computers likely will exhibit improved performance, because optimizing compilers for most architectures can take advantage of the array structure inherent in many operations. Fortran 90 also offers several other modern programming features that encourage better style and generally improve code structure, readability and maintainability, including but not nearly limited to: derived data types, or structures; modules that provide for explicit procedure interfaces and global variables; pointers; and dynamic memory allocation and management. Although Fortran 77 is considered a subset of Fortran 90 (F90 is completely backward compatible with F77), many of the problematic features of Fortran 77 are deprecated in Fortran 90 and declared obsolete. Common blocks, for example, which have led to more than a few recalcitrant programming bugs, are now unnecessary and will likely be declared obsolete in the next standard revision of the language, Fortran 2000.

Missing from this book are the theoretical background and other text that accompany and so nicely describe the algorithms in Volume 1. After two introductory chapters and one describing a host of Fortran 90 utility functions devised for the algorithms presented later, each chapter parallels one of the chapters in Volume 1. Most of the text in these chapters is composed of the algorithms