Diagnostic Ultrasound Imaging: Inside Out
By Thomas L. Szabo
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As a graduate student in medical physics I often encounter textbooks on a given imaging modality providing a comprehensive look at the essential physics with outdated examples, or excellent reviews of current applications with little to offer on the basic theory behind the modality. It was rather refreshing to come across this text by Thomas L. Szabo which covers the essential introductory physics and signal processing concepts of ultrasound as well as a breadth of advanced topics, including findings from the latest ultrasound research, all in a neat 540-page package.

Dr. Szabo is a Research Professor in the departments of Biomedical Engineering and Aerospace & Mechanical Engineering at Boston University. He is a fellow of the Acoustical Society of America and spent nearly 20 years in ultrasound research and development at Hewlett Packard (later Agilent).

This book has 15 chapters: 1) Introduction; 2) Overview; 3) Acoustic Wave Propagation; 4) Attenuation; 5) Transducers; 6) Beamforming; 7) Array Beamforming; 8) Wave Scattering and Imaging; 9) Scattering from Tissue and Tissue Characterization; 10) Imaging Systems and Applications; 11) Doppler Modes; 12) Nonlinear Acoustics and Imaging; 13) Ultrasonic Exposimetry and Acoustic Measurements; 14) Ultrasound Contrast Agents and 15) Ultrasound-induced Bioeffects.

Chapter 1 gives a historical overview of ultrasound, from the beginnings of sonar to current technologies and provides the reader with a comparison between existing imaging modalities. For those with little background in signal processing, chapter 2 introduces the Fourier Transform and signal processing concepts in the time and frequency domains using a building block approach that is carried through to the rest of the book. Additional information on Fourier Transforms and their applications are included as an appendix. Chapters 3 through 8, as well as chapter 10 comprise, what I consider, the "core" of the book, covering the essential physics, signal processing and application of ultrasound. The remainder of the book covers a variety of advanced topics. These range from imaging techniques such as Doppler ultrasound and color flow imaging, harmonic imaging and microbubble contrast agents to the use of ultrasound for tissue and transducer characterization and, finally, a chapter on the bioeffects of ultrasound as they relate to safety and to therapeutic applications.

Though the basic theoretical building blocks are covered, making this book accessible to the complete beginner reader in ultrasound, a background in mathematics and physics, specifically an understanding of calculus, complex numbers and some knowledge of electric circuits, is essential to fully benefit from this text. Graduate students in medical physics and biomedical engineering will find this book most useful as it provides a very comprehensive overview of ultrasound imaging physics with the option to progress to more advanced topics. Nevertheless, this book will also serve as a great reference for researchers, engineers and physicists well versed in ultrasound as its coverage of advanced topics is not trivial and includes the work of hundreds of contributors to the field.

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