Ultrasound in Med. & Biol., Vol. 30, No. 5, p. 703, 2004

0301-5629/04/$–see front matter

ELSEVIER

Book Review

PHYSICAL PRINCIPLES OF MEDICAL ULTRASONICS (2ND EDITION)

Edited by C. R. Hill, J. C. Bamber, G. R. ter Haar, Wiley, 2004, 511 pp

This book is largely the product of the Medical Ultrasonics group at the Royal Marsden Hospital in the UK, and all the editors are very well-known in the ultrasonics community. The first edition of this book, published in 1986, established itself as a major work. The second edition follows the same overall theme as the first: an extensive, often mathematical, description of the physical principles underlying medical ultrasound (US). The title contains the term "physical principles," not "instrumentation." The book does not purport to cover detailed signal-processing techniques relevant for particular clinical applications, and several times it is stated that "this is not intended to be a user handbook."

There are 15 chapters, starting with a highly mathematical description of acoustic theory, followed by chapters on acoustic fields and their measurement. The next three chapters cover aspects related to the propagation of US through tissue; attenuation and absorption, speed of sound, reflection and scattering. There is a chapter describing the relationship between macroscale quantities (bulk modulus, etc.) and the molecular processes in tissues (see below). The remaining chapters are divided between techniques for clinical use, and a superb three-chapter finale on biophysics and bioeffects.

The most interesting chapter for this reviewer is that on "physical chemistry of the US-tissue interaction." This describes two classes of acoustical quantity, one that is mainly influenced by tissue composition and one that is influenced by tissue architecture. The fact that molecular composition is virtually identical for all soft tissues is the reason that bulk tissue properties (absorption coefficient, bulk elastic modulus, speed of longitudinal wave propagation) are each very similar for different tissues. However, quantities influenced by tissue architecture (shear modulus, shear viscosity, scattering coefficient, speed of shear wave propagation) vary by 7 orders of magnitude between tissues. This is important for lesion detection, which relies on detectable differences in the values of imaged quantities. The chapter concludes by noting that shear properties are 2 orders of magnitude better than bulk properties in their potential ability for lesion detection, and there is a whole class of imaging techniques that are in their infancy being developed to exploit this. This is tremendous news for those of us looking for new opportunities in research.

There are a number of omissions in the book: the field of US tomography is hardly described at all, the measurement of complex 3-D flow patterns is not mentioned, nor is the use of numerical techniques for estimation of acoustic fields. However, these are minor issues compared with the huge wealth of information in this book.

The book has a strong mathematical content; hence, it will be mainly suitable for science and engineering readers.

This is an excellent update to the first edition of this book and should form a standard reference for many years to come.

Edinburgh, UK PETER HOSKINS

doi:10.1016/j.ultrasmedbio.2004.03.013