

## Ultrasound in Medicine

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The research book is devoted to ultrasonic methods of medical diagnostics, therapy and surgery. Design, calculations and practical applications of ultrasonic devices and systems used in medicine are presented in the book.

Ultrasonic diagnostics enables to obtain information about the internal structure of biological objects by using the phenomena of reflection, absorption and transmission of waves. Ultrasound of low intensity and high frequency enables to achieve high resolution. The upper limit of the used mechanical frequencies is limited by the growth of the coefficient of absorption with increasing frequency. Contemporary combined methods of diagnostics, which simultaneously use ultrasound and information from other physical fields, are widely used.

Ultrasonic waves, their characteristics and acoustical properties of biological materials are described in detail. The main relationships describing the propagation of ultrasonic waves are presented. Reflection and transmission of ultrasonic waves at the boundaries of fluids and elastic bodies are analyzed. The principles of creation of ultrasonic transducers on the basis of piezoelectric effect, magnetostriction effect and some other methods are presented. Concentrators of ultrasonic vibrations are described and several methods of their calculation are presented.

Physical effects taking place during the propagation of ultrasonic waves, such as radial pressure, acoustic flows, acoustic cavitation and others are described and their medical applications are presented. Mechanical and electrical systems of ultrasonic scanning are investigated. Directivity characteristics of ultrasonic transducers and methods of their calculation are presented. The use of nonlinear effects based on higher harmonics in ultrasonic diagnostics is described. Ultrasonic transmission tomography, the use of the Doppler Effect for investigations of moving biological structures, acoustic thermometry as well as other methods and effects are analyzed. Ultrasound is used for the determination of elastic properties of biological tissues. Surface acoustic waves are used for investigation of the properties of biological materials. Those methods and effects are not only described in detail, but also the design of medical devices and descriptions of their applications are provided.

Computer-aided design systems for ultrasonic devices are described. They are divided into two groups: general purpose programs for calculation of electromechanical devices and special purpose programs for design of ultrasonic devices. Problems of synthesis of ultrasonic devices of unknown geometrical parameters that ensure resonance at a given frequency are determined. The main software for solution of those problems is reviewed.

Harmful effects of ultrasound on human beings and methods of evaluation of those effects and protection from them are presented.

This book is based on the investigations performed by the well-known leading scientists of Belarus and Lithuania in this field.

The book is recommended for scientists, researchers and engineers, which are involved in design, calculations and practical applications of ultrasonic devices and systems. It may also be useful for physicians interested in applications of ultrasonic devices in their everyday work.