

Preface

Diagnostic and therapeutic Ultrasound has recently taken an explosive growth for better safer, economic, mobile and high quality healthcare. This technology is very appealing for medical applications because it is non-ionizing, non-invasive and is available in most of the medical and clinical facilities. Its low cost, when compared with other medical image modalities, makes it one of the preferred tools for medical monitoring, follow-up and diagnosis. Besides the traditional fields of cardiology and obstetrics, where it is extensively used for long time, it has become also very useful in the diagnosis of diseases of the prostate, liver and coronaries and carotids atherosclerosis.

However, Ultrasound images present poor quality, very low signal to noise ratio and a lot of artifacts. The extraction of useful information from Ultrasound data for diagnosis is a challenge task that makes this medical image modality a very active field of research. The difficulties are being overcome and novel and advanced methods are being proposed for detection, characterization and segmentation of abnormalities in several organs. In fact, Ultrasound application range is vast, covering almost all organs, including the brain where *Transcranial Doppler* (TCD) Ultrasound is very important to assess the brain vasculature.

This book presents some of the recent advances in Ultrasound imaging technology covering several organs and techniques in a *Biomedical Engineering* (BME) perspective. The focus of the book is in the algorithms, methodologies and systems developed by multidisciplinary research teams of engineers and physicians for *Computer-Aided Diagnosis* (CAD) purposes.

Cardiovascular and cancer, the most common life-threatening diseases in western countries, are two of the most important topics focused in the book. However, other advanced issues are also presented such as *Intravascular Ultrasound* (IVUS), 3D and 4D Ultrasound and Ultrasound in *Computer-Aided Surgery* (CAS). Some chapters are direct contributions from medical research groups where Ultrasound has also received great attention in the last decade. By this, new techniques based on Ultrasound were introduced in the clinical practice for diagnosis and therapeutics, mainly in hospital facilities.

Main Feature of the Book

The book contains 14 chapters distributed by 3 sections. It covers a wide range of topics from the physics and statistics associated with the Ultrasound data, in a signal processing point of view, up to high level application tools for CAD based on Ultrasound.

Section 1: Image Formation and Preprocessing

In this section the image formation process is addressed and new statistical models describing the ultrasonic signal are proposed. Reduction of Ultrasound noise, called de-speckling, and textural characterization of tissues are considered.

Section 2: Ultrasound Atherosclerotic Plaque Imaging

Here, the important problem of atherosclerotic plaque characterization is addressed. Methods to assess the severity of the disease are described, such as measuring the *Intima/Media Thickness* (IMT), as well as new scores to quantify the risk of vascular accident.

Section 3: Advanced Applications

This section covers a wide range of applications involving morphological and textural segmentation of structures from ultrasound images. Detection and characterization of focal lesions in the thyroid, breast and prostate and textural characterization of diffuse diseases of the liver are the main topics.

Ultrasound Imaging

Advances and Applications

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