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Thème

PROPRIÉTÉS NON LINÉAIRES DES TISSUS APPLIQUÉES À L'IMAGERIE ULTRASONORE

NONLINEAR TISSUS PROPERTIES APPLIED TO ULTRASOUND IMAGING

Soutenue le : 15 juillet 2010
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NONLINEAR TISSUS PROPERTIES

APPLIED

TO ULTRASOUND IMAGING

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to my mother.
to the memory of my father.

Abstract

Abstract

The main aim of the work in this thesis is to exploit nonlinear tissues properties for improving in medical ultrasound image quality.

Ultrasound imaging techniques have been widely used in modern hospitals for clinical ultrasound diagnosis because they can provide important information on the diseased state of the tissues in a human body non-invasively and non-destructively.

Ulrasound imaging is based on the generation, detection and processing of acoustic waves. The waves are transmitted into the human body, and on encountering variations in the properties of the medium, the waves are scattered and reflected. These reflections therefore contain information on the structures and shapes inside the body. When they are intercepted, the backscattered acoustic echoes are then beamformed and processed to form an image.

The standard approach for ultrasound imaging is to use the fundamental frequency from the reflected signal to form images. Tissue harmonic imaging is a new gray-scale imaging technique, which use harmonic information from nonlinear ultrasound propagation to form an image. It creates images that are derived solely from the higher frequency.

The properties of tissue cause the primary ultrasound signal to distort in the body. The distortion of this signal causes harmonics to be generated in tissue and these harmonics can then be used to generate an ultrasound image. The properties of these harmonic signals that can offer several advantages including improved contrast resolution, reduced noise and clutter, improved lateral resolution, reduced artefacts (side lobes, reverberations).

In this thesis, second harmonic component generation has been used to create images offering improvements over conventional B-mode images in penetration, spatial resolution and, more significantly, in the suppression of acoustic clutter and side-lobe artefacts.

In ultrasound harmonic imaging, an ongoing problem is that undesired signals are contained in the reflected waves, and that corrupt the image data, which leads to the contamination of the obtained image. Harmonic received frequency band must not contain components from transmit band, and its components must sufficiently be separable from fundamental spectral component. Thus, to effectively employ the information contained in the second harmonic of the received signal, this information should be properly extracted. In this thesis, a new technique for acquiring the proper second harmonic signal is presented; an optimization of the transmitted bandwidth is recommended to receive the purely second harmonic signal for harmonic imaging. Given a certain available bandwidth for the transducer, it must be decide in what band the transmitted pulse may be send at, and what band the second harmonic signal should be received at.

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