METHODS FOR MEASURING ULTRASONIC BACKSCATTER AND ATTENUATION COEFFICIENTS FOR TISSUES AND TISSUE-LIKE MEDIA (HUMAN LIVER)

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Measurements of fundamental acoustic properties of biological tissues, in vivo, may provide information useful for improving the diagnostic value and image quality of ultrasound scanning. Also, in the clinical environment, such measurements may be useful for characterizing the pathological state of many soft tissues.

In this dissertation, a new method for measuring ultrasonic backscatter coefficients is described. An important aspect of this method is that an exact representation of the transducer pressure field has been included in the analysis of echo signal data. Measurements employing this analysis for a sample consisting of a well defined system of scatterers were found to agree with theoretical values calculated from first principles. The influence on measurement accuracy of parameters such as sample gate duration, incident pulse bandwidth, and attenuation of the transducer beam along the transmission path have been investigated using ultrasonically tissue-mimicking (TM) materials. TM phantoms were constructed to simulate various aspects of in vivo measurements, particularly the effects of fat-to-nonfat interfaces, for assessing the feasibility of applying this analysis, in vivo. Uncertainties in attenuation estimates were found to significantly reduce the accuracy for measuring backscatter coefficients.

The interdependence between attenuation and backscatter values had led to the investigation of a method for estimating attenuation coefficients, in vivo. A spectral technique for measuring attenuation, which includes diffraction effects, was tested for accuracy using tissue-mimicking phantoms having known acoustic properties. Results of attenuation measured for normal human liver, in vivo, are presented.