on. More complex situations require alternate
ample, transskull impediography is difficult
ons introduced by the presence of skull bone.
propagation of sound through skull shows that
m, at least for focused beams, remains virtually
he temporal characteristics are severely altered.
egeneration is a result of frequency dependent
th reflections, mode conversion, curvature,
e importance each of these effects plays in
c signal propagated through the skull will be
resentation. Also, a number of transskull
described and several alternative processing
ull impediography will be presented.

ACOUSTIC IMPEDANCE PROFILING--AN EXPERIMENTAL MODEL AND ANALYTICAL STUDY WITH IMPLICATIONS FOR MEDICAL DIAGNOSIS

A. C. Kak, F. J. Fry* and Narendra T. Sanghvi*
Department of Electrical Engineering, Purdue University, Lafayette, Indiana 47906; *Indianapolis Center for Advanced Research, Indiana University Medical Center, Indianapolis, Indiana 46202

Acoustic parameter characterization in a quantitative manner of soft tissues in the human body leading to tissue typing is a potentially powerful method for clinical medicine for the identification and differentiation of disease entities in a non-invasive manner. This study is concerned with the determination of acoustic impedance profiles in physical models, some of which have impedance values in the range of body soft tissues. The physical models used are of a plane parallel face multilayer type, and the sound beam is at normal incidence to the plane face. Materials used in the model have been lucite, silastic rubber of varying compositions (to produce acoustic impedance differences of a few percent at a boundary) and ρc rubber. The sound beams used mostly have been those produced by focused transceivers (fundamental frequency 1MHz-2MHz) delivering a damped oscillatory wave. A more nearly unipolar pulse unfocused beam has also been used (supplied by Bolt, Beranek and Newman of Cambridge, Massachusetts under a subcontractual arrangement). The algorithms used for the study involve the determination of the impulse response of the medium; and from this impulse response, the impedance profile is computed.

The algorithm implemented for impulse response determination in this study uses the matched filtering technique, which is applicable to a rather generalized acoustic waveform (damped oscillatory wave). Computations of impedance are made in a stepwise fashion throughout the layered medium based on a priori knowledge of the impedance of the first layer and the determination of the reflection coefficient at the first and subsequent interfaces.

Attenuation in the interrogated model must be included if the impedance values are to be correct. Layer thickness is computed automatically since an acoustic velocity is inserted for each layer. Each layer has inserted an acoustic pressure absorption coefficient (α_n) so that the attenuation per layer is automatically computed from the layer thickness and the α_n.

The first implemented algorithm for impedance profiling is capable of handling twelve discrete layers, although in principle the method can be expanded to include the more medically realistic case of perhaps an order of magnitude larger number of reflection zones.

Experimental data show computed values of impedance profiles for models involving three and five layers (i.e., water-lucite-water-lucite-water) in which reproducibility of the impedance values made on the same target over a number of runs is maintained within a few percent of the average values. The magnitude of the computed impedance values are within 10% of the absolute values, which is considered quite good at this stage of development.

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