REAL TIME DATA PROCESSING SYSTEM FOR ACOUSTICAL TISSUE CHARACTERIZATION

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ABSTRACT

The ultrasonic pulse-echo technique, widely used in non destructive testing and medecine, uses a part of the echo content yielding only qualitative image. In order to extract quantitative information from echographic signals, characterization techniques were developped since the early 80's Most of them are based on the power spectrum estimation of received signals. However in most cases data processing is time consuming and prevents real time display of the data. In order to shorten this time we assembled a Fourier transformer which allows to perform a 1024 points Fourier transform in 2 ms. The whole data processing, system can be conneted to any commercial acoustical imaging system, if necessary through a radio-frequency signal digitalizer.

The material characterization techniques were developped in order to extract quantitative information from the radiofrequency (RF) echographic signals. The sound celerity acoustical impedence or medium attenuation are often modified by pathology. Each of these properties could be used as a pertinent parameter in tissue characterization In médical applications the tissue attenuation (a) emerges as promising parameter [1-4] Because attenuation is frequency dependant most of the available algorithms are based on the power spectrum estimation of the windowed back-scattered signal, each window corresponding to a selected slice of scattered medium Due to the random distribution of the scatters selected by each window the calculated spectrum is rather noisy In order to reduce the random noise one uses a sliding window in order to extract maximum spectral information present in each echo-line. It was shown in our laboratoy that at least 256 uncorrelated A-type lines were needed to detect a significant variation in ultrasonic attenuation due to a particular pathology [5] However the data processing using a conventional micro computer takes about two hours

In order to reduce the time of data processing and to permit the reaquisition of inconsistent data we constructed a "real time" Fourier transform unit which allows us to calculate a 1024 points Fourier transform in 2 ms The system assembled in our laboratory permits a real time calculation of the tissue attenuation variation with frequency It can be easily connected to any echo-B scan type system having a digitalized RF output. In clinical routine a(f) value is computed and displayed six seconds after the end of the acquisition of the last echographic line instead of two hours needed previously. Although it was unambigously shown that the tissue characterization technique is a powerful tool in detection of severe diffuse pathology [5]. The extra-medical applications of this technique are less common. Obviously non-destructive material testing and the food industry are the future domains of application of this powerful and relatively low cost technique

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