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Quantitative Assessment of Soft Tissues by Statistical Analysis of Ultrasound Backscattered Signals

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Abstract : Ultrasound signals backscattered from the soft tissues are mainly depending on the size, density, distribution, and other elastic properties of scatterers in the interrogated sample volume. The quantitative analysis of ultrasonic backscattering is frequently implemented using the statistical approach due to that of backscattering signals tends to be with the nature of the random variable. Thus, the statistical analysis, such as Nakagami statistics, has been applied to characterize the density and distribution of scatterers of a sample. Yet, the accuracy of statistical analysis could be readily affected by the receiving signals associated with the nature of incident ultrasound wave and acoustical properties of samples. Thus, in the present study, efforts were made to explore such effects as the ultrasound operational modes and attenuation of biological tissue on the estimation of corresponding Nakagami statistical parameter (m parameter). In vitro measurements were performed from healthy and pathological fibrosis porcine livers using different single-element ultrasound transducers and duty cycles of incident tone burst ranging respectively from 3.5 to 7.5 MHz and 10 to 50%. Results demonstrated that the estimated m parameter tends to be sensitively affected by the use of ultrasound operational modes as well as the tissue attenuation. The healthy and pathological tissues may be characterized quantitatively by m parameter under fixed measurement conditions and proper calibration.

Keywords : ultrasound backscattering, statistical analysis, operational mode, attenuation
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