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Improved cancer detection and classification using multi-parameter quantitative ultrasound

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Quantitative ultrasound (QUS) has been used successfully to differentiate benign from malignant solid tumors in animal models of breast cancer. In these studies, QUS made use of estimates of average scatterer diameter (ASD) and average acoustic concentration (AAC) from the ultrasonic backscatter. However, initial attempts to classify different kinds of malignant tumors based on ASD and AAC estimates were not successful. New models for ultrasonic backscatter were created by considering the cytoskeletal structure of cells. In addition, the homodyned K distribution was used to model the amplitude of the envelope from regions-of-interest in the malignant tumors. The homodyned K distribution yielded two parameters: the S parameter, which quantified the randomness of scatterer spacings, and the β parameter, which quantified the amount of clustering of scatterers in the interrogated tissue. Statistically significant differences ($P < 0.05$) were observed between average S and β parameters from the malignant tumors. Furthermore, statistically significant differences ($P < 0.05$) were observed between ASD and AAC estimates from the malignant tumors using the new scattering models at ultrasonic frequencies above 16 MHz. The use of four parameters, as opposed to two, improved the ability to uniquely classify different kinds of malignant tumors. [Supported by NIH R01CA111289]