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Modeling scattering from cells and biological structures

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The goal of ultrasonic tissue characterization is to extract information over and above the information conventionally displayed on imaging instruments which is typically the backscatter strength (B-mode image). The driving hypothesis of our work is that as the ultrasound wavelength approaches the size of a cell, the backscatter characteristics become more sensitive to the cells' physical attributes (size, structure and composition) and changes in the cell structure due to therapeutic intervention. A better understanding of the interaction of acoustic waves with cells is required to interpret the backscatter data. An overview of our efforts to model scattering from individual cells, cell ensembles, and in-vivo cancer will be presented. Theoretical results will be presented comparing scattering from individual cells with experimental data from a variety of cells in suspension, cell ensembles with pellets (compact aggregates of cells) and in-vivo tumors. It will be shown that for the tumors we have studied there is a very good correlation of scattering characteristics between cell pellets and in-vivo tumors, indicating that in the tumors studied cell structure was the factor that dominated the scattering response. The goal of this work is to use quantitative ultrasound methods for diagnosis and monitoring the response to therapy.