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Temperature-dependent diffusing acoustic wave spectroscopy with resonant scatterers

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The influence of a slight temperature change on the correlation of multiply scattered acoustic waves is studied, and experimental results are discussed. The technique presented here, similar to diffuse acoustic wave spectroscopy, is based on the sensitivity of a multiple scattering medium to a slight change. Ultrasonic waves around 3 MHz are transmitted through a sample made of steel rods in water and recorded by an array of transducers at different temperatures. The cross-correlations between highly-scattered signals are computed. The main effect of the temperature change is a simple dilation of the times of arrival, due to a change of the sound velocity in water. But the scatterers also play a role in the progressive decorrelation of waveforms. An analysis resolved in both time and frequency shows that at some particular frequencies, the resonant behavior of the scatterers are responsible for a significantly larger decorrelation.
Interestingly, the experimental results allow one to detect the presence of a small resonance that was not detected earlier on the same scatterers with classical measurement of the scattering mean free-path. A simple model is proposed to interpret the experimental results.