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Sensivity of the ultrasonic coda to a temperature change in the presence of resonant scattering

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The influence of a slight temperature change on the correlation of ultrasonic waves undergoing multiple scattering is studied, and experimental results are discussed. The technique presented here, similarly to ”diffuse acoustic wave spectroscopy”, or “coda correlation imaging” is based on the sensitivity of a multiple scattering medium to a slight change. Ultrasonic waves around 3 MHz are transmitted through a synthetic sample made of parallel steel rods in water, and recorded by an array of transducers at different temperatures. The transmitted waveforms exhibit a long-lasting coda due to multiple scattering. The cross-correlations between scattered signals before and after the temperature change are computed. As expected, 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 the ambient medium (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 behaviour 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 measurements of the scattering mean free-path. A simple model is proposed to interpret the experimental results.