Iterative reconstruction of the ultrasound attenuation coefficient from backscattered signals

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Introduction: Estimation of the local acoustic attenuation from backscattered signals has several clinical applications but remains an open problem. Most of the proposed solutions relate the observed spectral changes directly to the theoretical predictions. However, these methods make a number of approximations and require correction strategies for acoustic wave phenomena that are not accounted for in the model (e.g. non-linearity).

Methods: In this study, attenuation was estimated by successively solving the forward wave propagation problem for different attenuation coefficients and by matching the calculated backscattered signals to the observed one. For the forward problem, the effects of attenuation, nonlinear distortion, reflection and scattering were taken into account. The proposed approach was validated on simulated data and data recorded in 6 tissue mimicking phantoms and was compared to conventional methods.

Results: The relative error of the attenuation coefficient remained below 10% for the simulated and phantom data. The conventional methods showed a comparable performance on the simulated data, but their error significantly increased in the phantom study.

Discussion: The proposed method outperformed state-of-the-art attenuation estimators. Moreover, it can be used to estimate local non-linearity. In future work, the propagation model will be extended to 3D and diffraction effects will be included.