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Joint reconstruction of ultrasound and photoacoustic tomography images

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Photoacoustic computed tomography (PACT) is a bioimaging modality that seeks to reconstruct an estimate of the absorbed optical energy density within an object. We propose a joint reconstruction problem in which the speed-of-sound (SOS) distribution is concurrently estimated along with the sought-after absorbed optical energy density from the photoacoustic measurement data.

(2) Material and Methods

We will investigate the numerical properties of the JR problem for two cases: 1) only PACT data are available and 2) PACT and few-view USCT data are available and combined into a single data set. In the latter case, the SOS information in both the PACT data and the USCT data can be exploited. Realistic numerical phantoms that accurately model the geometry and acoustic heterogeneity of a rat or mouse will be employed. The results will be evaluated on the basis of accuracy when compared with the numerical phantoms. The impact of regularization, acoustic heterogeneity, and model mismatch (e.g. neglecting attenuation, impulse responses of the transducers, etc.) will be investigated.

(3) Results

We will present the results of a systematic study of the joint PACT-USCT image reconstruction problem. The study will address the impact of regularization parameters and data noise.

(4) Discussion and Conclusion

Because variations in the SOS distribution induce aberrations in the measured PA wavefields, certain information regarding an object's SOS distribution is encoded in the PACT measurement data. The purpose of this work was to contribute to a broad understanding of the extent to which the JR problem can be accurately and reliably solved under realistic conditions. This was accomplished by conducting numerical experiments that elucidated important numerical properties of the JR problem.

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