Washington University in St. Louis
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TRANSCRANIAL PHOTOACOUSTIC/THERMOACOUSTIC TOMOGRAPHY BRAIN IMAGING INFORMED BY ADJUNCT IMAGE DATA (COMBINED WITH 013043)

Anastasio, Mark, Huang, Chao, Nie, Liming, Schoonover, Robert, Wang, Lihong

Maland, Brett

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Existing high-resolution human brain imaging modalities such as X-ray computed tomography (CT) and magnetic resonance imaging (MRI) are expensive and employ bulky and generally non-portable imaging equipment. Moreover, X-ray CT is unsafe for patients who need long time monitoring of brain diseases or injuries. Alternatively, ultrasonography is an established portable pediatric brain imaging modality, but its image quality degrades severely when employed after the closure of the fontanels and therefore is not effective for imaging adults. The development of thermoacoustic tomography (TAT) and photoacoustic tomography (PAT) brain imaging methods would circumvent these limitations and result a powerful new brain imaging modality that would fill an important void left by the available techniques. A major technical challenge in PAT/TAT brain imaging is to compensate for the distortion introduced into the measurement data by the skull.

The present invention provides an image reconstruction methodology for PAT/TAT brain imaging that can effectively compensate for skull-induced image distortions. By use of information regarding the skull morphology and composition obtained from adjunct X-ray CT image data, a subject-specific imaging methodology has been developed that accounts for skull-induced aberrations. The image reconstruction methodology was evaluated in experimental studies involving phantoms and monkey heads. The results establish that our reconstruction methodology can effectively compensate for skull-induced acoustic aberrations and improve image fidelity in transcranial PAT and TAT brain imaging.