A Fast Forward Solver for Large-Domain Ultrasound Tomography

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A fast forward solver for large-domain ultrasound tomography problem is presented. Ultrasound tomography is a non-invasive imaging technique which is being considered for biomedical applications such as breast cancer imaging [1]. In this imaging technique, the object of interest is illuminated by ultrasound waves using transmitting transducers. The resulting pressure outside the object is then measured by some receiving transducers. This measured pressure is referred to as the total pressure measurement. The same measurement is also repeated in the absence of the object of interest. This new measured pressure is then referred to as the incident pressure measurement. The subtraction of these two sets of measurements results in the so-called scattered pressure data. The ultrasound tomography problem will find the compressibility profile as well the density profile of the object of interest using this measured scattered pressure data.

To create images from compressibility and density profiles using this measured scattered pressure data, two different iterative algorithms need to be developed: (1) an inverse solver algorithm, and (2) a forward solver algorithm. The inverse algorithm produces prediction of compressibility and density profiles of the object of interest at each iteration. On the other hand, the forward solver algorithm evaluates how good this prediction is. The focus of this presentation is on the forward solver algorithm. Previous work on forward solver algorithms for this application were mainly focused on utilizing linearization approximation or the development of the forward solver for some simplified scenarios such as having low contrast compressibility and density objects [1].

In this work, we report on the development of a forward solver based on the method of moments which has been accelerated by the use of the conjugate gradient method in conjunction with the fast Fourier transform. It will be shown that this method is superior to the Neumann series method, which has been used as a forward solver for this problem.

REFERENCES

INSTRUCTIONS

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Proceedings of the 2012 Graduate Students Conference, GRADCON 2012
Winnipeg, MB, Canada; October 12, 2012
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