Adaptive Kaczmarz method for cardiac activity reconstruction in electrical impedance tomography

Taoran Li[1], David Isaacson[1], Jonathan C. Newell[1], Gary J. Saulnier[1]

[1]Rensselaer Polytechnic Institute, Troy, USA, lit5@rpi.edu

Abstract: An adaptive Kaczmarz method to reconstruct conductivity changes from 2D EIT data is described. The framework to combine the adaptive Kaczmarz method and the adaptive mesh refinement is also outlined in the paper. Reconstructions from data collected on a human chest torso are shown. The results accurately recover the conductivity changes during a cardiac cycle and demonstrate the reconstruction performance of the adaptive Kaczmarz method.

1 Introduction

In this paper, we will outline a framework to combine the adaptive Kaczmarz method and the adaptive mesh refinement techniques. The adaptive algorithm can locally refine the mesh and generate optimal current patterns to improve the accuracy of the reconstructed images with the help of the prior information obtained from the previous iterations.

2 Methods

The adaptive Kaczmarz method was introduced and described in more detail in [1]. It combines the block Kaczmarz method and optimal current pattern generation. The algorithm avoids the inversion of large matrices at each iteration and adaptively generates optimal current patterns to improve the distinguishability of the system. It can solve the reconstruction problem cost-efficiently without degrading the quality of the reconstructed images.

2.1 Adaptive Kaczmarz with Adaptive Mesh Refinement

The proposed algorithm balances the trade-off between the accuracy and the efficiency of the EIT reconstruction process. With the help of adaptive mesh refinement, it is possible to avoid unnecessary mesh elements and improve the efficiency and the conditioning of the reconstruction. The flowchart of the adaptive algorithm is shown in Figure 1.

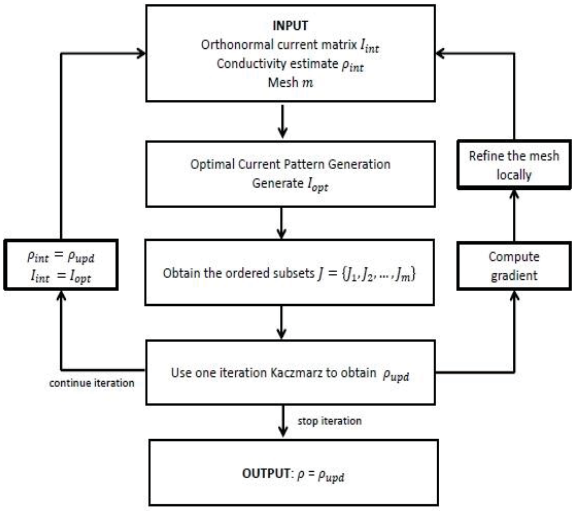

Figure 1: Flowchart of the adaptive algorithm

2.2 Results of the adaptive Kaczmarz

The images were reconstructed from archival data measured by the ACT3 system at Rensselaer Polytechnic Institute. In Figure 2, a sequence of 8 images in one cardiac cycle is displayed.

3 Conclusions

In this paper, reconstructions of cardiac activity using the adaptive Kaczmarz are shown and a new adaptive algorithm is outlined.

References

[1] Li T, Kao T, Isaacson D, Newell J C and Saulnier G. Adaptive kaczmarz method for image reconstruction in electrical impedance tomography *Physiol. Meas.* **34**:595–608, 2013

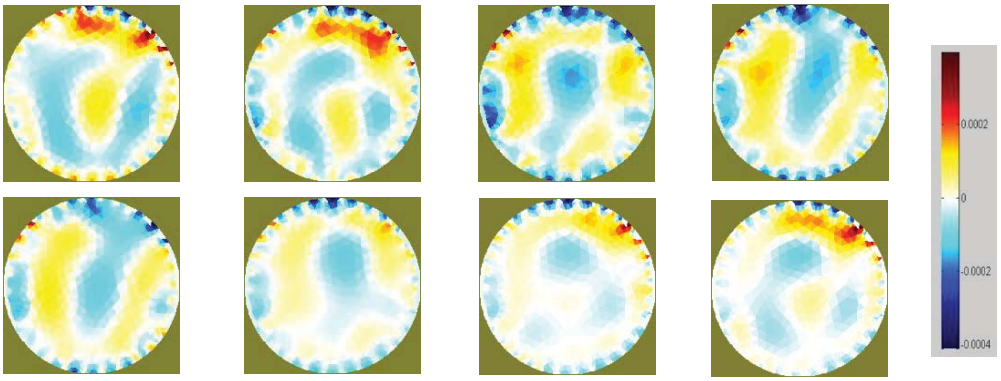

Figure 2: A sequence of 8 different images in one cardiac cycle is shown.

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Systems and Computer Engineering
Carleton University, 1125 Colonel By Drive
Ottawa, Ontario, K1S 5B6, Canada
adler@sce.carleton.ca
+1 (613) 520-2600

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