

# EE798 Remote Image Formation Theory Project

Analysis and Reimplementation of

*Improving the spatial solution of electrocardiographic imaging:*

*A new regularization parameter choice technique for the*

*Tikhonov method*

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## I. INTRODUCTION

Electrocardiographic Imaging (ECGI) is a noninvasive method for reconstructing the epicardial potentials from the body surface potential mapping that can diagnose diseases such as tachycardia [1] and atrial fibrillation [2], [3]. The number of measurement non-invasively taken from the torso surface, however, is less than the number of reconstructed cardiac sources that provides satisfactory spatial resolution for the diagnosis. Due to the inherent ill-posedness of this underdetermined problem, utilization of regularization is mandatory to achieve physiologically suitable solutions [4]. Tikhonov Regularization is a widely used regularization technique in ECGI community and has been found to outperform the other methods depending on the formulation of the problem [4]. The regularization technique imposes a prior on the inverse problem solution and weights the candidate solutions with the data-fidelity term in the cost function with a regularization parameter  $\lambda$ . Chamorro-Servent, *et al.*, proposes a new method called Automated Discrete Picard Condition (ADPC) in their study [5] to automatically find a suitable regularization parameter  $\lambda$ . This project report investigates the idea reported in *Improving the spatial solution of electrocardiographic imaging: A new regularization parameter choice technique for the Tikhonov method* [5].

The organization of the report is as follows:

- The problem and the proposed solutions to it are briefly introduced in this section.
- The background of ECGI and theory of the regarding inverse problem are discussed in Section Theory.
- The methods, datasets and neural network architectures used in the implementation of the original paper along with modifications introduced in the speech emotion recognition tasks can be seen in Section Implementation.
- Section Results and Discussion is left for the presentation of the results from conducted experiments along with the original results presented in the study and the discussion comparing the performances of the related method.

## II. THEORY

### A. ECGI Forward Problem

### B. ECGI Inverse Problem

### C. Tikhonov Regularization

### D. Parameter Choice Techniques

## III. IMPLEMENTATION

## IV. RESULTS

## V. RESULTS AND DISCUSSION

## REFERENCES

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