

Hybrid Optimization in Photoacoustic Image Reconstruction: Integrating NSGA-III and Tikhonov Regularization

by

Maximiliano Galindo
Author Qualifications

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Master of Science

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Abstract

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Finishing a PhD is like moving a mountain. Luckily, you only have to move one rock at a time.

(Reddit somewhere: pg. ??)

Acknowledgements

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Contribution statement

Declaration by author

(this section is presently incomplete)

Supervisors

Title. Supervisor One¹, Title. Supervisor Two², Title. Supervisor Three¹, and Title. Supervisor Four^{3,4}

¹A *long* affiliation (e.g., School)
allows for three (e.g., Faculty)
lines to be specified (e.g., Institution)

²A *short* affiliation (e.g., Department)
only has two (e.g., Company)

³A supervisor may have
multiple affiliations

⁴An affiliation may be used by
multiple supervisors

List of publications

(this section is presently incomplete)

Publications included in this thesis

(to be completed)

Submitted manuscripts included in this thesis

(to be completed)

Other publications during candidature

(to be completed)

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Chapter 1

Introduction

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1.1 Photoacoustic Imaging

1.1.1 Research Questions

This research will investigate Lorem ipsum dolor sit amet, consectetur adipiscing elit.. Specifically, this research will provide a foundation for Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis.. From this foundation, Curabitur dictum gravida mauris..

The research question is as follows:

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Donec vehicula augue eu neque. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. As such, this research has been discretised as to be addressed in the following sub-questions:

RQ1: *Lorem ipsum dolor sit amet, consectetur adipiscing elit.*

RQ2: *Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis.*

RQ3: *Curabitur dictum gravida mauris.*

RQ4: *Nam arcu libero, nonummy eget, consectetur id, vulputate a, magna.*

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1.1.2 Contributions

This research provides the following contributions to knowledge:

C1: Lorem ipsum dolor sit amet, consectetur adipiscing elit..

C2: Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis..

C3: Curabitur dictum gravida mauris..

C4: Nam arcu libero, nonummy eget, consectetur id, vulputate a, magna..

C5: Donec vehicula augue eu neque..

C6: Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas..

1.2 Image Reconstruction

1.3 Multi-Objective Optimization

1.4 Overview

The format of this thesis is by publication, so I will be also attempting to publish this research as the following papers:

P1: This is the full title of my first paper (RQ1; C1)

P2: This is where I would put my second paper *if I had any* (RQ2; C2, C3)

P3: You get the idea (RQ3; C4, C5)

P4: ... (RQ4; C6)

Chapter 2

Literature review

2.1 Photoacoustic Imaging

2.1.1 Fundamentals of Photoacoustic Imaging Reconstruction

2.1.2 Linear State Space Model for Photoacoustic Imaging Reconstruction

2.2 Regression Methods

2.2.1 Least Squares Regression

2.2.2 Ridge Regression

2.2.3 Regularization

Lasso

Tikhonov Regularization

2.3 Multi-Objective Optimization for Image Reconstruction

2.3.1 Introduction to Multi-Objective Optimization

2.3.2 NSGA-III

2.4 Hybrid Optimization

2.5 Limitations and Challenges in Photoacoustic Imaging Reconstruction

Chapter 3

Methodology

3.1 Simulation and Experimental Setup

3.2 Regression Methods for Image Reconstruction

3.3 Multi-Objective Optimization for Image Reconstruction

3.4 Hybrid Optimization for Image Reconstruction

Here are
visuals
to include

some				interesting			
you		might		maybe		like	
Y	N	Y	N	Y	N	Y	N

Figure 3.1: Here is something about the table

A chair!

Chapter 4

Experiments and Results

This chapter presents the experiments conducted to evaluate the proposed approach. The experiments are divided into three parts. The first part is a comparison of the regularized and multi-objective optimization approaches in one dimension. The second part is a comparison of the regularized and the hybrid optimization approaches in one dimension. The third part is a comparison of the regularized and the hybrid optimization approaches in two dimensions. The results are presented in the form of tables and figures. The tables show the results of the experiments in terms of the number of evaluations, the number of generations, the number of solutions in the Pareto front, and the hypervolume. The figures show the Pareto fronts of the solutions obtained by the algorithms.

4.1 Experiments in one dimension

4.1.1 Regularized vs Multi-objective optimization

4.1.2 Regularized vs Hybrid optimization

4.2 Experiments in two dimensions

4.3 Something meaningful



Figure 4.1: Just as genes propagate themselves in the gene pool by leaping from body to body via sperms or eggs, so memes propagate themselves in the meme pool by leaping from brain to brain via a process which, in the broad sense, can be called imitation. (Quote by Richard Dawkins, *The Selfish Gene*)

Chapter 5

Analysis

Note: Here I could write something to provide some meta-information for an annual review, if I wanted to.

5.1 Advantages and Limitations of the Regression and Regularization Approach

5.2 Advantages and Limitations of the Multi-objective Optimization Approach

5.3 Advantages and Limitations of the Hybrid Optimization Approach

Chapter 6

Conclusion

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References

Bibliography