Random Osborne Algorithm for Matrix Balancing

Optimal transport report

Alexi Canesse[1,2]

Optimal transport course
Part of the MVA program at ENS Paris-Saclay.

MATHÉMATIQUES
VISION
APPRENTISSAGE

Computer Science and Mathematics
École Normale Supérieur Paris-Saclay
Orsay, France
4th January 2024

1 alexi.canesse@ens-lyon.fr, ENS de Lyon, France
2 alexi.canesse@ens-paris-saclay.fr, ENS Paris-Saclay, France

Table of content

1 Introduction (3 pages) **1**

1.1 Presentation of the problem 1

1.2 Related work 1

1.3 Contributions 1

2 Main body (10 pages) **1**

2.1 Presentation of the method 1

2.2 Theoretical guarantees 2

2.3 Numerics 2

3 Conclusion and perspective **2**

4 Connexion with the course **2**

Abstract (½ page): What problem(s) is studied? Why is it relevant? What solution(s) is proposed? Which contributions (theory, numerics, etc) ?

Accurate physics simulations can be computationally expensive due to the requirement of fine meshes. However, a cost-effective approach involves reducing the mesh size while retaining crucial features required for the simulation. Some of these features are conveniently represented in the spectra of Laplacians operators defined on the mesh. There exists a coarsening method that filters out unnecessary spectral bands. The challenge lies in determining which spectral bands are important for the simulation, as ***this information is largely unknown****.*

To address this, we propose a ***novel approach*** *to guide the coarsening process using* ***insights from physical simulations****. By learning the spectral subspaces that significantly influence the simulation outcomes, we can create a coarse mesh that retains the characteristics essential for an accurate simulation. Main contributions are:*

- *A novel spectral optimization method for coarsening, with physical simulations in mind.*
- *Understanding importance of spectral subspaces: By understanding the spectral subspaces that contribute the most to the simulations, we gain valuable insights into the underlying physics and behavior of the system.*
- *Faster simulation times: The reduced mesh size leads to a considerable speed-up in the simulation process, making it more efficient and feasible for practical applications.*

1 Introduction (3 pages)

1.1 Presentation of the problem

1.2 Related work

Previous works (at least a few citations). If relevant, include things that you have seen during the MVA course (or possibly other courses).

1.3 Contributions

Contributions. Why is the studied method different/better/worse/etc. than existing previous works.

2 Main body (10 pages)

2.1 Presentation of the method

Include variants etc

2.2 Theoretical guarantees

2.3 Numerics

3 Conclusion and perspective

Summary of the result obtained: pros and cons (limitation, problems, error in the articles, etc) Possible improvement/extension

4 Connexion with the course

MANDATORY SECTION:. What are the notions/results/algorithms presented in the course that are used or related to the one presented in this paper?