Overview of Spectral Algorithms Research Team

He Sun

THE UNIVERSITY of EDINBURGH

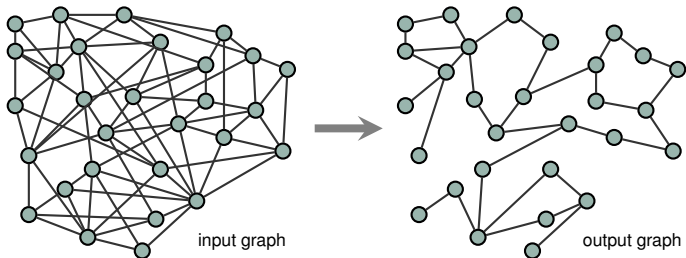Engineering and Physical Sciences Research Council

The Team

- He Sun

- Peter Macgregor, Postdoctoral Researcher

- Danny Vagnozzi, Postdoctoral Researcher

- Ben Jourdan, PhD Student

- Steinar Laenen, PhD Student

Research Agenda

Foundations

Algorithms

Applications

Spectral (Hyper-)graph Theory

Spectral Sparsification

Graph Clustering

STAG: an open-source algorithmic library

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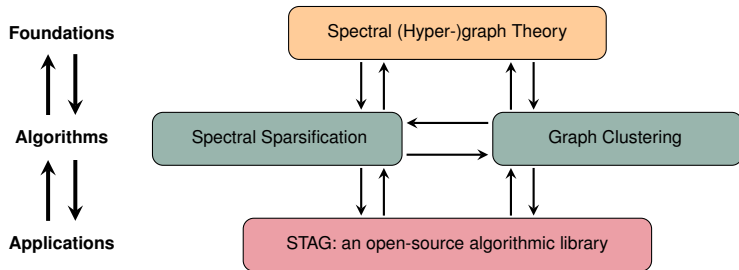
Constructing Unweighted Graph Sparsifiers

input graph → output graph

QUESTION

Can we efficiently construct an <u>unweighted</u> sparsifier for certain graphs?
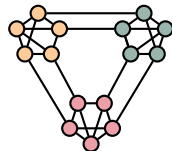
Close connection to the Algorithmic Kadison-Singer Problem

Learning Clusters with Certain Structures

CLASSICAL CLUSTERING OBJECTIVE
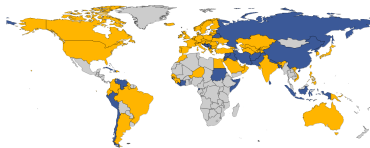
Partition vertices of a graph into clusters wrt. edge densities.
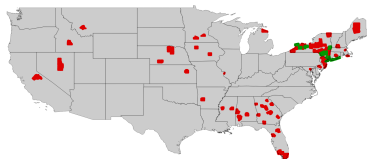
OUR RESEARCH

Design efficient algorithms that find clusters organised in certain ways.

NeurIPS'20, ICML'21, NeurIPS'21, ICML'22

Interstate Dispute between 1990-2010

Migration trend to NY (US Migration Dataset)

STAG: **S**pectral **T**oolkit of **A**lgorithms for **G**raphs

- The first C++ based open-source library of spectral graph algorithms

- STAG website: `https://staglibrary.io`

Example: Studying Wikipedia Graph with STAG

```
match (n1)-[]-(n2) where n1.title="Laboratory for Foundations of Computer
Science" return n1, n2
```

Research outside Algorithms & Complexity

- Computer Vision: Human Motion Parsing by Hierarchical Dynamic Clustering
  - Y. Zhang, S. Tang, H. Sun, H. Neumann (BMVC'18)

- Deep Learning: On Episodes, Prototypical Networks, and Few-Shot Learning
  - S. Laenen, L. Bertinetto (NeruIPS'21)

- Database Theory: Measuring the Impact of a Database
  - P. Buneman, D. Dosso, M. Lissandrini, G. Silvello, H. Sun (2022, submitted)

Thank you

Group Trip to Ben Nevis, May 2022