

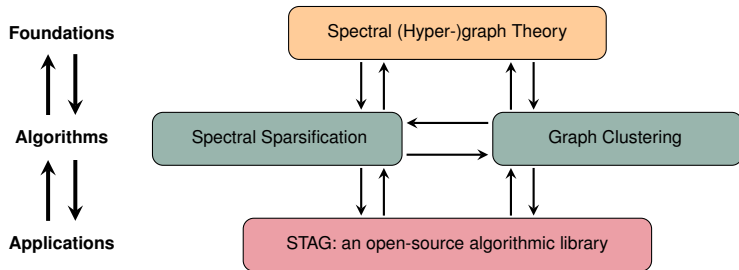
Overview of Spectral Algorithms Research Team

He Sun

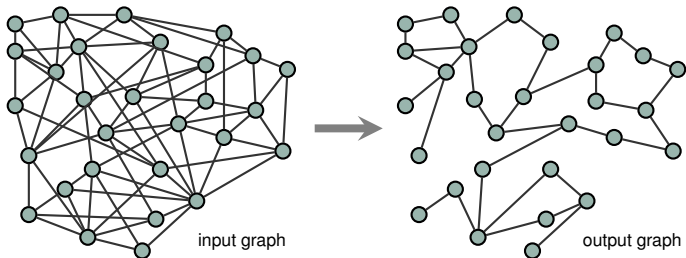
The Team

- He Sun
- Peter Macgregor, Postdoctoral Researcher
- Danny Vagnozzi, Postdoctoral Researcher
- Ben Jourdan, PhD Student
- Steinar Laenen, PhD Student

Research Agenda



Constructing Unweighted Graph Sparsifiers



QUESTION

Can we efficiently construct an unweighted sparsifier for certain graphs?

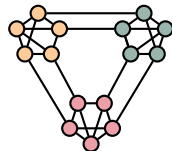
Close connection to the Algorithmic Kadison-Singer Problem



Learning Clusters with Certain Structures

CLASSICAL CLUSTERING OBJECTIVE

Partition vertices of a graph into clusters wrt. edge densities.

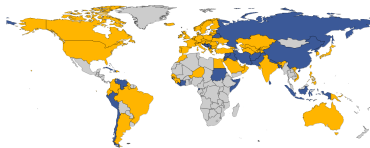


OUR RESEARCH

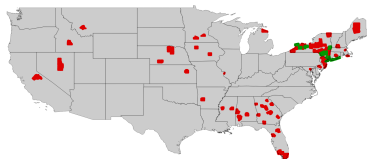
Design efficient algorithms that find clusters organised in certain ways.

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

Interstate Dispute between 1990-2010



Migration trend to NY (US Migration Dataset)



STAG: Spectral Toolkit of Algorithms for Graphs



- The first C++ based open-source library of spectral graph algorithms
- STAG website: <https://staglibrary.io>


staglibrary.io

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STAG Library

Spectral Toolkit of Algorithms for Graphs

STAG is an open-source library for efficient spectral algorithms. It is the first such algorithmic library mainly written in C++, with a python wrapper STAGPy around the underlying C++ library for python users. Our project starts in September 2022, and is under active development.



About Us


This project is part of He Sun's 5-year EPSRC Fellowship titled "Efficient Spectral Algorithms for Massive and Dynamic Graphs" with a total award of 1.5 million pounds. The STAG team is based in the School of Informatics, University of Edinburgh, United Kingdom.

Code
You can find STAG's source code from our [GitHub page](#).

Funding Information
UK Engineering and Physical Sciences Research Council, EP/T07239/1

Local Graph Clustering

Given a vertex of some underlying graph as input, a local graph clustering algorithm is to find some low-conductance set around the input vertex, while the algorithm runs in time proportional to the size of the target cluster and independent of the size of the entire graph. As one of the key components in designing nearly-linear time graph algorithms, local graph clustering algorithms have been extensively studied in algorithmic spectral graph theory.



Example: Studying Wikipedia Graph with STAG



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



- **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 (NerulIPS'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