# Xue Gong

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## Education

**The University of Edinburgh** *Edinburgh, UK*
PhD in Applied Mathematics *Sep 2019 - Nov 2023*
- MAC-MIGS CDT scholarship, Doctoral Training Programme with Integrated Study in Mathematical Modelling, Analysis and Computation
- **Supervisors**: Des Higham, Kostas Zygalakis
- **Thesis:** Laplacians for Structure Recovery on Directed and Higher-order Graphs
- **Research Interests:** Graph-based algorithms, Graph models, Node embedding, Spectral clustering, Graph mining, Learning on graphs

**National University of Singapore** *Singapore*
M.Sc in Statistics (Honours with Distinction) *2017 - 2019*

**Nanyang Technological University** *Singapore*
BSc (Hons) in Physics (First Class Honours) *2011 - 2015*
- Dean's List (top 5% of cohort)
- Singapore Government Merit Undergraduate Scholarship

## Awards

**Turing Enrichment Award** *London, UK*
Alan Turing Institute *Oct 2022*
Offer PhD students the opportunity to enrich and enhance their current research by accessing the facilities and opportunities available at The Alan Turing Institute and its partners as well as a grant to undertake research activity.

**Associate Fellowship** *UK*
Advanced Higher Education *Sep 2022*
In recognition of attainment against the UK Professional Standards Framework for teaching and learning support in higher education

**Outstanding Talk Award** *Online*
SIAM Workshop on Network Science (NS22) *Sep 2022*

**Teaching Award** *UK*
The University of Edinburgh *Sep 2022*

**Laura Wisewell Travel Scholarship** *UK*
The University of Edinburgh *Jun 2022*

**MATH+ Thematic Einstein Semester Summer School Travel Award** *Germany*
Zuse Institute Berlin *Jun 2022*

**MAC-MIGS Travel Fund** *UK*
EPSRC *2019 - 2023*

**MAC-MIGS CDT Scholarship (Fully Funded)** *UK*
EPSRC *2019*

**Dean's List (top 5% of cohort)** *Singapore*
Nanyang Technological University *2014*

**Singapore Government Merit Undergraduate Scholarship (Fully Funded)** *Singapore*
Ministry of Education of Singapore *2011*

## Publications

- **Gong, X.**, Higham, D.J. and Zygalakis, K. Generative hypergraph models and spectral embedding. *Scientific Report* 13, 540 (2023). https://doi.org/10.1038/s41598-023-27565-9

- **Gong, X.**, Higham, D.J. and Zygalakis, K., 2021. Directed network Laplacians and random graph models. *Royal Society open science*, 8(10), p.211144.

- Lu, X., Utama, M.I.B., Lin, J., **Gong, X.**, Zhang, J., Zhao, Y., Pantelides, S.T., Wang, J., Dong, Z., Liu, Z. and Zhou, W., 2014. Large-area synthesis of monolayer and few-layer MoSe2 films on SiO2 substrates. *Nano letters*, 14(5), pp.2419-2425.

## Manuscript

- **Gong, X.**, Higham, D.J., Zygalakis, K., and Bianconi. G. Connection Hodge Laplacian for Directed Simplicial Complexes.

## Talks & Presentations

**Conference on Complex Systems 2022 (CCS 2022)** — *Palma de Mallorca, Spain*
Poster Presentation, *"Spectral Embedding and Associated Generative Models for Hypergraphs"* — *Oct 2022*

**SIAM Workshop on Network Science** — *Online*
Outstanding Talk Award, Lightning Talk, *"Generative Hypergraph Models and Spectral Embedding"* — *Sep 2022*

**4th IMA Conference on The Mathematical Challenges of Big Data** — *Oxford, UK*
Contributed Talk, *"Hypergraph Generative Models and Associated Spectral Embedding Algorithms"* — *Sep 2022*

**Conference on Network Science (NetSci)** — *Online*
Contributed Talk, "Hypergraph Generative Models and Associated Laplacians" — *Jul 2022*

**AAAI 2022 Workshop on Graphs and More Complex Structures for Learning and Reasoning** — *UK*
Short Paper, "Visualizing and Quantifying Linear and Periodic Structures in Directed Networks" — *Feb 2022*

**Oxford Network Seminar** — *Online*
Seminar Talk, "Random Graph Interpretation of Directed Graph Laplacians" — *Dec 2021*

**10th International Conference on Complex Networks & Their Applications** — *Online*
Contributed Talk, "Random Graph Interpretation of Directed Graph Laplacians" — *Nov 2021*

**Conference on Complex Systems** — *Online*
Contributed Talk, "Directed Random Graph Models and Their Associated Laplacians" — *Oct 2021*

**Oxford-Warwick-Edinburgh Network Science Workshop** — *Online*
Contributed Talk, "Mapping Directed Networks Using the Magnetic Laplacian" — *Mar 2021*

**Cambridge Joint CDT Student Conference** — *Online*
Contributed Talk, "Mapping Directed Networks Using the Magnetic Laplacian" — *Dec 2020*

## Events Participation

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|---|---|---|
| Jun 2022 | **Mathematics of Complex Social Systems Summer School**, Participant | *Berlin, Germany* |
| Jul 2021 | **Networks 2021 (Joint Sunbelt and NetSci Conference)**, Participant | *Online* |
| Jun 2021 | **SIAM-IMA Edinburgh - Study Group with Industry** , Participant in the project "Generating Irregular Sequences for Seismic Imaging Problems" | *Online* |
| Dec 2020 | **Conference on Complex Systems 2020 (CCS 2020) online**, Participant | *Online* |
| Sep 2020 | **Agrifood Data Study Group: Evaluating the UK's resilience to supply chain shocks**, Participant | *Online* |
| May 2020 | **ICMS and MAC-MIGS Modelling Camp 2020**, Participant | *Edinburgh, UK* |

## Teaching Experience

**MATH08058 Calculus and its Applications** — *The University of Edinburgh*
Tutor and Marker — *Spring 2022*
- An undergraduate course offered to College of Science and Engineering students to develop calculus skills
- Facilitated weekly problem-solving tutorials, marked assignments and final exams

**MATH11197 Research Skills for Computational and Applied Mathematics** — *The University of Edinburgh*
Tutor and Marker — *Fall 2020*
- A Master's level course to develop research skills through a set of programming exercises, workshops and group projects
- Facilitated programming workshops, soft-skill workshops; marked programming assignments and final reports

**School of Physical and Mathematical Sciences Learning Centre** — *Nanyang Technological University*
Peer Tutor — *2014*
- One-to-one tutoring with undergraduate students on Fluid Mechanics, Classical Mechanics, Quantum Mechanics, and experiment modules

## Research Projects

### Directed Laplacian on Simplicial Complexes
*Edinburgh, UK*

Turing Enrichment Scheme
*Aug 2022 - Now*
- **Collaborators**: Ginestra Bianconi, Desmond Higham ,Konstantinos Zygalakis
- Developed theories for directed simplicial complexes
- Extended directed graph Laplacian such as the Magnetic Laplacian to higher-order graphs

### Spectral Embedding and Generative Hypergraph Models
*Edinburgh, UK*

The University of Edinburgh
*Aug 2021 - Aug 2022*
- **Supervisors**: Desmond Higham ,Konstantinos Zygalakis
- Studied spectral algorithms for hypergraphs that captures higher-order interactions
- Established the connection between novel random graph models and spectral algorithms
- Performed numerical experiments on synthetic and real hypergraph from social sciences for node embedding, clustering, and link prediction

### Visualizing and Quantifying Structures in Directed Networks
*Edinburgh, UK*

The University of Edinburgh
*May 2020 - Aug 2021*
- **Supervisors**: Desmond Higham ,Konstantinos Zygalakis
- Analyzed spectral algorithms for clustering and mapping directed graphs
- Derive associated random graph models and proposed workflow for comparing structures based on the models
- Ran experiments on synthetic and real networks from ecology, biology and social sciences for graph visualization and structure recovery

### Efficient Approximation of Pricing Functions
*Edinburgh, UK*

The University of Edinburgh
*Jan - Mar 2020*
- **Supervisors**: Aretha Teckentrup, Abdul-Lateef Haji-Ali
- Enhanced the efficiency of option price estimation by by generating training data using multi-level Monte Carlo, and estimating price function using Gaussian process regression

### Opinion Dynamics
*Edinburgh, UK*

The University of Edinburgh
*Oct - Dec 2019*
- **Supervisor**: Ben Goddard
- Simulated and studied the behaviors of opinion dynamics models including the voter model, the Deffuant model and the HK model

### Modified Dealer's Model for the Electricity Market
*Singapore*

Nanyang Technological University
*Aug 2014- May 2015*
- **Supervisor**: Cheong Siew Ann
- Modelled the spiking behaviour of the electricity market using modified dealer's model; studied the spike statistics and the impact of model parameters

### The Minority Game Model
*Singapore*

Nanyang Technological University
*Jun 2012 - Aug 2012*
- **Supervisor**: Chew Lock Yue
- Simulated the dynamics of a system using the Minority Game Model and studied the influence of agent memory and strategy pool on the volatility of the system

## EVENTS CO-ORGANIZED

### MAC-MIGS Research Afternoon on Learning Complex Structures on Graphs
*Edinburgh, UK*

MAC-MIGS CDT
*Jul 2022*

Invited speakers to present recent advances in the research on learning graph structures, such as clustering and structure recovery on graphs and hypergraphs

### Networks Book Club

Online
*2021- 2022*

Held regular online meetings to discuss books and topics on network science, such as graph representation learning, dynamics and modularity on graphs, and natural language processing

### Networks Reading Group
*Edinburgh, UK*

The University of Edinburgh
*2022 - Now*

Ran regular face-to-face meetings in Edinburgh to discuss papers on graphs and networks covering topics such as graph neural networks, community detection, and spectral clustering

## Reviewer

Neurocomputing

## PROFESSIONAL SOCIETIES

Society for Industrial and Applied Mathematics

The Institute of Mathematics and its Applications

## Other Experience

**Quantitative Analyst** *Singapore*
Rio Tinto *Apr 2017 - Jul 2019*
Built statistical models such as time series forecasting; designed optimization model for planning and scheduling
**Geophysicist** *Singapore*
CGG *Jul 2015 - Apr 2017*
Performed seismic image processing using techniques such as inversion algorithm, wave equation, and signal processing

## Skills

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|---|---|
| **Programming** | Python, Matlab R, C/C++, HTML/CSS, SQL |
| **Miscellaneous** | Linux, Shell, LaTeX, Tableau, Power BI, Git |
| **Languages** | English, Chinese |

## Languages

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|---|---|
| **English** | Professional proficiency |
| **Chinese** | Native proficiency |