# Curriculum Vitae
## Sinan G. Aksoy


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| Office Address: | Pacific Northwest National Laboratory<br>PO Box 999<br>MSIN: K7-28<br>Richland, WA 99352 | Email:<br>Website:<br>Phone:<br>Citizenship: | sinanaksoy90@gmail.com<br>www.sinanaksoy.com<br>509-375-2564<br>United States |


### Research Interests

Applied combinatorics and network science, spectral and extremal graph theory, stochastic processes on graphs, mathematics of data science.

### Education

2014 – 2017 **Ph.D., Mathematics**, University of California, San Diego.
Advisor: Fan Chung Graham

2012 – 2014 **M.A., Applied Mathematics**, University of California, San Diego.

2008 – 2012 **B.A., Mathematics, B.A., Economics** University of Chicago.
*General Honors*

### Professional Experience

2017 – **Data Scientist**, Pacific Northwest National Laboratory

2016 Sum. **Intern**, Pacific Northwest National Laboratory.

2015 Fall **Visiting Scholar**, National Taiwan University, Mathematics Division NCTS.

2015 Sum. **Intern**, Sandia National Laboratories, Livermore.

### Journal Articles

2021 34. I. Amburg, S. Aksoy, *Tensor methods for nonuniform hypergraphs*, in preparation.

33. S. Aksoy, H. Jenne, E. Purvine, S. Young, *Rapid Generation and Parameter Recovery of Correlated Temporal Graphs*, in preparation.

32. K. Hayashi, S. Aksoy, H. Park, *Skew-symmetric adjacency matrices for clustering directed graphs*, submitted.

31. S. Aksoy, E. Purvine, S. Young, *Directional Laplacian centrality for cyber situational awareness*, Digital Threats: Research & Practice, **2** (4):1–28, 2021, DOI: 10.1145/3450286

2020 30. S. Aksoy, M. Kempton, S. Young, *Spectral threshold for extremal cyclic edge-connectivity*, Graphs and Combinatorics, 1–15, 2021, DOI: 10.1007/s00373-021-02333-6

29. S. Aksoy, C. Joslyn, C. Ortiz-Marrero, B. Praggastis, E. Purvine, *Hypernetwork science via high-order walks*, EPJ Data Science, **9**(16), 2020, DOI: 10.1140/epjds/s13688-020-00231-0

28. S. Aksoy, P. Bruillard, S. Young, M. Raugas, *Ramanujan graphs and the spectral gap of supercomputing topologies*, Journal of Supercomputing, DOI: 10.1007/s11227-020-03291-1

2019 27. S. Aksoy, K. Nowak, E. Purvine, S. Young, *Relative Hausdorff distance for network analysis*, Applied Network Science, **4**(80), 2019, DOI: 10.1007/s41109-019-0198-0

26. S. Aksoy, K. Nowak, S. Young, *A linear-time algorithm and analysis of graph Relative Hausdorff distance*, SIAM J. Mathematics of Data Science, **1**(4):647–666, 2019, DOI: 10.1137/19M1248224

2018 25. S. Aksoy, F. Chung, M. Tait, J. Tobin, *The maximum relaxation time of a random walk*, Advances in Applied Mathematics, **101**:1–14, 2018, DOI: 10.1016/j.aam.2018.07.002

24. S. Aksoy, E. Purvine, E. Cotilla-Sanchez, M. Halappanavar, *A generative graph model for electrical infrastructure networks*, Journal of Complex Networks, **7**(1):128–162, DOI: 10.1093/comnet/cny016

2017 23. S. Aksoy, T. G. Kolda, A. Pinar, *Measuring and modeling bipartite graphs with community structure,* Journal of Complex Networks, **5**(4):581–603, 2017, DOI: 10.1093/comnet/cnx001

2016 22. S. Aksoy, F. Chung, X. Peng, *Extreme values of the stationary distribution of random walks on directed graphs,* Advances in Applied Mathematics, **81**:128–155, 2016, DOI: 10.1016/j.aam.2016.06.012

21. S. Aksoy, P. Horn, *Graphs with many strong orientations,* SIAM J. Discrete Math., **30**(2):1269–1282, 2016, DOI: 10.1137/15M1018885

2015 20. S. Aksoy, A. Azzam, C. Coppersmith, J. Glass, G. Karaali, X. Zhao, X. Zhu, *Coalitions and cliques in the school choice problem*, Involve, **8**(5):801–823, 2015, DOI: 10.2140/involve.2015.8.801

2012 19. S. Aksoy, S. Nelson, *Bikei, involutary biracks, and unoriented link invariants*, Journal of Knot Theory and Its Ramifications, **21**(6):13 pp., 2012, DOI: 10.1142/S0218216511009972

## Refereed Conference & Workshop Proceedings

2021 18. X. Liu, J. Firoz, A. Lumsdaine, C. Joslyn, S. Aksoy, I. Amburg, A. Gebremedhin, B. Praggastis, *A scalable framework for computation of high-order line graphs of nonuniform hypergraphs*, submitted.

17. S. Roy, S. Aksoy, S. Sarker, P. Weng, S. Young, *Structural Controllability Assessment for Inverter-Based Microgrids*, The 53rd North American Power Symposium (NAPS 2021), to appear.

16. X. Liu, J. Firoz, A. Lumsdaine, C. Joslyn, S. Aksoy, B. Praggastis, A. Gebremedhin, *Parallel Algorithms and Heuristics for Efficient Computation of High-Order Line Graphs of Hypergraphs*, HiPC 2021: 28th IEEE COnference on High Performance Computing, Data, & Analytics, arXiv:2010.11448

15. S. Aksoy, S. Young, J. Firoz, R. Gioiosa, M. Raugas, J Contreras, J. Wilke, *SpectralFly: Ramanujan Graphs as Flexible and Efficient Interconnection Networks*, submitted, arXiv:2104.11725

2020 14. K. Hayashi, S. Aksoy, C. Park, H. Park, *Hypergraph random walks, Laplacians, and clustering*, *Proceedings of the 29th ACM International Conference on Information & Knowledge Management.*, p. 495-504, 2020, DOI: 10.1145/3340531.3412034

13. C. Joslyn, S. Aksoy, D. Arendt, L. Jenkins, B. Praggastis, E. Purvine, M. Zalewski, *Hypergraph Analytics of Domain Name System Relationships*, Workshop on Algorithms and Models for the Web Graph, p. 1-15, 2020, DOI: 10.1007/978-3-030-48478-1_1

12. C. Joslyn, S. Aksoy, T. Callahan, L. Hunter, B. Jefferson, B. Praggastis, E. Purvine, I. Tripodi, *Hypernetwork Science: From Multidimensional Networks to Computational Topology*, International Conference on Computational Science 2020.

11. X. Fan, S. Aksoy, D. Wang, Q. Huang, J.P. Ogle, A. Tbaileh, R. Huang, *Automated Realistic Testbed Synthesis for Power System Communication Networks based on Graph Metrics*, 2020 IEEE Conference on Innovative Smart Grid Technologies North America, DOI: 10.1109/ISGT45199.2020.9087672

2018 10. L. Jenkins, T. Bhuiyan, S. Harun, C. Lightsey, D. Mentgen, S. Aksoy, T. Stavenger, M. Zalewski, H. Medal, C. Joslyn, *Chapel HyperGraph Library (CHGL)*, 2018 IEEE High Performance Extreme Computing Conference (HPEC 18), DOI: 10.1109/HPEC.2018.8547520

9. E. Purvine, S. Aksoy, C. Joslyn, K. Nowak, B. Praggastis, M. Robinson, *A topological approach to representational data models*, In International Conference on Human Interface and the Management of Information, pp. 90–109. Springer, Cham, DOI: 10.1007/978-3-319-92043-6_8

2012 8. S. Aksoy, A. Azzam, C. Coppersmith, J. Glass, G. Karaali, X. Zhao, X. Zhu, *School Choice as a One-Sided Matching Problem: Cardinal Utilities and Optimization*, 2012 International Symposium on Artificial Intelligence, arXiv:1304.7413

### Technical Reports & Book Chapters

2021 7. S. Volkova, D. Arendt, E. Saldanha, M. Glenski, E. Ayton, J. Cottam, S. Aksoy, B. Jefferson, K. Shrivaram, *Causal Discovery and Prediction of Human Behavior and Social Dynamics from Observational Data*, Computational and Mathematical Organization Theory.

2020 6. S. Aksoy, J. Taft, *Connectivity, Centrality, and Bottleneckedness: On Graph Theoretic Methods for Power Systems*, Tech. Rep. PNNL-29662, PDF

2019 5. X. Fan, S. Aksoy, Q. Huang, J.P. Ogle, D. Wang, A. Tbaileh, and T. Fu, *Coordination of Transmission, Distribution and Communication Systems for Prompt Power System Recovery after Disasters Report*, Tech. Rep. PNNL-28598, PDF

4. Q. Huang, A. Tbaileh, S. Sharma, Q. Li, S. Aksoy, X. Fan, and R. Huang, *Mechanisms and data needed for coordinating restoration*, PNNL Tech. Rep. PNNL-28387

### Expository Articles

2022 3. S. Aksoy, *Advice From Our Advisor: Fan Chung*, Notices of the American Mathematical Society, to appear, 2022.

2021 2. S. Aksoy, A. Hagberg, C. Joslyn, B. Kay, E. Purvine, S. Young, *Models and Methods for Sparse (Hyper)Network Science in Business, Industry and Government*, Notices of the American Mathematical Soceity, to appear, 2021

1. S. Aksoy, R. Gioiosa, M. Raugas, S. Young, *Expanding the Horizon: The Future of HPC Networking is Bottleneck-Free Topologies*, The Next Wave, to appear, 2021

### Software

- **Chapel Hypergraph Library** (Chapel) – Scalable hypergraph generation & analysis, contributor.
- **HyperNetX** (Python) – Hypergraph visualization and exploratory data analytics, contributor.
- **Transactive Energy Simulation Platform** (Python) – Valuation and simulation of energy market mechanisms and participants, contributor.

### Patents

- **Methods and Systems for Evaluating Data Transportability in Distribution Grids**, Determination of Transportability Index, IPID: 32155-E

### Professional Service

- **Workshop Co-organizer**: AMS Mathematics Research Communities (2022)
  *Models and Methods for Sparse (Hyper)Network Science*, [link]
- **Guest Editor**: Journal of Combinatorics, Special Issue on Applied Combinatorial Methods (2021)
- **Conference Session Co-organizer**
  - Applied Combinatorial Methods, Joint Mathematics Meetings (2022)
  - Graph Theory and its Applications, Canadian Mathematical Society Winter Meeting (2022)
  - Applied Combinatorial Methods, Joint Mathematics Meetings (2021), [link]
- **Reviewer**: Mathematical Reviews, MathSciNet

- **Referee**: Journal of Combinatorics, Theoretical Computer Science, Linear Algebra & Applications, Graphs & Combinatorics, SIAM J. Math Data Science, SIAM Undergraduate Research Online, Journal of Algebraic Combinatorics, Ars Combinatoria, Network Science
- **Graduate Student Association Representative**, UC San Diego Math Department (2015-2016)
- **Webmaster**, "Erdős' Problems on Graphs" website (2014-2015)

## Talks

2021 Aug. **Pacific Northwest National Laboratory**(Mathematics for Biology Bootcamp)
Invited Talk: *Graph Theory for Data Science*

2020 Dec. **University of Washington** (Probability Seminar)
Invited Talk: *Random walks on graphs and hypergraphs: eigenvalues and clustering*

Oct. **AMS Fall Western Sectional** (Session on Graphs and Matrices)
Invited Talk: *Hypergraph random walks, Laplacians, and clustering*

Oct. **University of Washington** (Applied Mathematics Seminar)
Invited Talk: *Random walks on graphs and hypergraphs: eigenvalues and clustering*, [video]

2019 Sep. **AMS Fall Central Sectional** (Session on Combinatorics, Functions and Logic)
*The maximum relaxation time of a random walk*

2018 Jan. **AMS Joint Math Meetings** (Special Session: Applied and Computational Combinatorics)
Invited Talk: *A generative graph model for electrical infrastructure networks.*

2017 June **UC San Diego** (Final Defense)
*Random walks on directed graphs and orientations of graphs.*

Apr. **AMS Sectional**, Washington State University (Clustering of Graphs: Theory & Practice)
Invited Talk: *Measuring and modeling bipartite graphs with community structure.*

2016 Nov. **Purdue University** (Geometry Seminar)
Invited Talk: *Problems in the spectral theory of directed and oriented graphs.*

Oct. **AMS Fall Sectional**, University of Denver (Analysis on Graphs & Spectral Graph Theory)
Invited Talk: *Extreme values of the stationary distribution of random walks on directed graphs.*

Aug. **Pacific Northwest National Laboratory** (NSIP Symposium)
*A generative graph model for the power-grid.*

June **UC San Diego** (Stochastic Networks Conference: Short Talk & Poster Session)
*Extreme values of the stationary distribution of random walks on directed graphs.*

Feb. **Claremont Colleges** (Algebra, Number Theory, & Combinatorics Seminar)
Invited Talk: *Strong orientations of graphs and Cheeger's inequality.*
**UC San Diego** (Advancement to Candidacy Seminar)
*Two problems on the spectral theory of directed graphs*

Jan. **AMS Joint Math Meetings** (Special Session on Research from the GRWC)
Invited Talk: *Graphs with many strong orientations.*

2015 Sep. **Sandia National Laboratories, Livermore** (Seminar)
*A generative bipartite graph model with affiliation structure.*

2014 Aug. **University of Denver** (Graduate Research Workshop Open Problem Seminar)
*The connectivity of randomly oriented graphs.*

2010 July **Pomona College** (NSF-funded REU Seminar)
*Game theory in school choice.*

## Teaching and Interns

2019– **Intern Supervisor**, Pacific Northwest National Laboratory

- Nicholas Landry (graduate), University of Colorado Boulder, Fall 2021
- Ilya Amburg (graduate), Cornell University, Summer 2021
- Mirah Shi (undergraduate), Barnard College, Summer 2021
- Sankar Harilal (high school), Hanford High School, Summer 2021
- Terran Mott (undergraduate), Grinnell College Summer 2019

2020 **Research Group Lead**, Washington Experimental Math Lab, University of Washington
Mentees: Haley Riggs, Chuan Shi, Jiaqi Su

2016–2017 **Head Teaching Assistant**, UC San Diego Math Department
Responsibilities: training and evaluating new TAs, serving as a first point of contact for conflicts and grievances, representing graduate students in departmental affairs.

2012–2016 **Teaching Assistant**, UC San Diego Math Department
12 Courses: Discrete Math & Graph Theory, Combinatorics, Complex Analysis, Mathematical Reasoning, Linear Algebra, Calculus and Analytic Geometry, Calculus I-III.

## Fellowships and Awards

2019 **Author of the Year**, Pacific Northwest National Laboratory, National Security Directorate
2016 Jun. **Outstanding Poster Award**, Stochastic Networks Conference
2013–2014 **Graduate Student Research Fellowship**, UC San Diego
2012–2013 **Graduate Assistance in Areas of National Need Fellowship**, UC San Diego
2012–2013 **M. Salah Baouendi Graduate Fellowship**, UC San Diego
2012 Jun. **General Honors**, University of Chicago