

Mihai Cucuringu

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EMPLOYMENT

University of Oxford Oxford, UK

- Associate Professor, Department of Statistics (Sept. 2018 - Present)
- Non-Tutorial Fellow - Stipendiary Lecturer in Statistics, Merton College (Sept. 2018 - Present)
- Affiliate Faculty, Mathematical Institute (Sept. 2018 - Present)

The Alan Turing Institute London, UK

- Turing Fellow (Sept. 2018 - Present)

University of Oxford and Alan Turing Institute Oxford/London

- Alan Turing Research Fellow, Department of Statistics and Mathematical Institute (Jan. 2017 - Aug. 2018)

University of California at Los Angeles (UCLA), Los Angeles, California

- CAM Assistant Adjunct Professor, Department of Mathematics (July 2013 - June 2016) (on leave Aug. - Dec. 2014)

University of California at Berkeley, Berkeley, California

- Simons Research Fellow, Simons Institute for Theoretical Computing (Aug. - Dec. 2014)

EDUCATION

Princeton University, Princeton, NJ (Sept. 2007 - May 2012)

- Ph.D. in Applied and Computational Mathematics (2009-2012). Advisor: Amit Singer
- Thesis: *Graph Realization and Low-Rank Matrix Completion*. (R. Calderbank, I. Kevrekidis, P. Seymour) (May 2012)
- M. A. in Applied and Computational Mathematics (2007-2009)
- Generals: *Uniqueness of Low-Rank Matrix Completion by Rigidity Theory*. (A. Singer, R. Calderbank, P. Seymour)
- Preliminary exams: Combinatorics, Optimization, Stochastic Modeling. (R. Calderbank, S. Dayanik, R. Vanderbei)

Hiram College, Hiram, OH (August 2003 - May 2007)

- B.A. in Mathematics, Computer Science, and Economics

Technical University of Budapest, Hungary (Fall 2005) Budapest Semesters in Mathematics - study abroad program

RESEARCH INTERESTS

Development and mathematical analysis of algorithms for data science, network analysis, and certain computationally-hard inverse problems on large graphs, with applications to various problems in machine learning, statistics, finance, and engineering, often with an eye towards extracting structure from time-dependent data which can be subsequently leveraged for prediction purposes.

- spectral and semidefinite programming algorithms, group synchronization, ranking, clustering, phase unwrapping
- nonlinear dimensionality reduction and diffusion maps, intrinsic slow variables in dynamic data
- networks: community and core-periphery structure, anomaly detection
- statistical analysis of financial data: statistical arbitrage, market microstructure, limit order books, risk models
- low-rank matrix completion, distance geometry problems, rigidity theory, applications to sensor network localization and 3D structuring of molecules

REFEREED JOURNAL PAPERS

1. M. Cucuringu, R. Erban, "ADM-CLE approach for detecting slow variables in continuous time Markov chains and dynamic data", *SIAM Journal on Scientific Computing*, 39(1), B76-B101 (2017)
2. M. Cucuringu, M. P. Rombach, S. H. Lee, M. A. Porter, "Detection of Core-Periphery Structure in Networks Using Spectral Methods and Geodesic Paths", *European Journal of Applied Mathematics*, Vol. 27, No. 6: 846-887 (2016)
3. M. Cucuringu, "Sync-Rank: Robust Ranking, Constrained Ranking and Rank Aggregation via Eigenvector and Semidefinite Programming Synchronization", *IEEE Transactions on Network Science and Engineering*, 3 (1): 58–79 (2016)
4. M. Cucuringu, "Synchronization over Z_2 and community detection in multiplex networks with constraints", *Journal of Complex Networks*, 3 (3):469-506 (2015)
5. S. H. Lee, M. Cucuringu, M. A. Porter, "Density-Based and Transport-Based Core-Periphery Structures in Networks", *Physical Review E*, Vol. 89, No. 3: 032810 (2014)
6. M. Cucuringu, V. Blondel, P. Van Dooren, "Extracting Spatial Information from Networks with Low Order Eigenvectors", *Physical Review E* 87, 032803 (2013)
7. M. Cucuringu, A. Singer, D. Cowburn, "Eigenvector Synchronization, Graph Rigidity and the Molecule Problem", *Information and Inference: A Journal of the IMA*, 1 (1), pp. 2167 (2012)
8. M. Cucuringu, Y. Lipman, A. Singer, "Sensor Network Localization by Eigenvector Synchronization over the Euclidean Group", *ACM Transactions on Sensor Networks*, 8 (3), pp. 1-42 (2012)
9. E. Allen, F. Blanchet-Sadri, C. Byrum, M. Cucuringu, and R. Mercas, "Counting Bordered Partial Words by Critical Positions", *The Electronic Journal of Combinatorics*, Vol. 18 (2011)
10. F. Blanchet-Sadri, M. Cucuringu, "Counting primitive partial words", *Journal of Automata, Languages and Combinatorics* 15, 3/4, 199-227 (2010)
11. A. Singer, M. Cucuringu, "Uniqueness of Low-Rank Matrix Completion by Rigidity Theory", *SIAM Journal on Matrix Analysis and Applications*, 31 (4), pp. 1621-1641 (2010)
12. M. Cucuringu, R. Strichartz, "Infinitesimal Resistance Metrics on Sierpinski Gasket Type Fractals", *Analysis*, 28 (2008)
13. M. Cucuringu, R. Strichartz, "Self-Similar Energy Forms on the Sierpinski Gasket with Twists", *Potential Analysis*, 27 (2007)

REFEREED CONFERENCE PAPERS

1. M. Cucuringu, H. Tyagi, "On denoising modulo 1 samples of a function", *AISTATS 2018*
2. M. Cucuringu, C. Marshak, D. Montag, P. Rombach, "Rank Aggregation for Course Sequence Discovery in Educational Data", *Complex Networks 2017*
3. M. Cucuringu, I. Koutis, S. Chawla, G. Miller, and R. Peng, "Simple and Scalable Constrained Clustering: A Generalized Spectral Method", *AISTATS 2016 (Artificial Intelligence and Statistics Conference)*
4. M. Cucuringu, J. Woodworth, "Ordinal Embedding Of Unweighted Knn Graphs Via Synchronization", *25th IEEE International Workshop on Machine Learning for Signal Processing (MLSP) (2015)*

TECHNICAL REPORTS

1. M. Cucuringu, M.W. Mahoney, "Localization on low-order eigenvectors of data matrices", *Technical Report*, arXiv:1109.1355 (2011)
2. M. Cucuringu, J. Puente, and D. Shue, "Model Selection in Undirected Graphical Models with Elastic Net", *Technical Report*, arXiv: 1111.0559 (2010)

BOOK CHAPTER

1. M. Cucuringu, "An Eigenvector Synchronization Algorithm for the Graph Realization Problem", in A. Mucherino, C. Lavor, L. Liberti, N. Maculan (Eds.), *Distance Geometry: Theory, Methods and Applications*, 410 pages, Springer (2013)

SUBMITTED

1. M. Cucuringu, H. Tyagi, "Provably robust estimation of modulo 1 samples of a smooth function with applications to phase unwrapping", arxiv: 1803.03669 (2018)
2. A. Tsokos, S. Santhosh, I. Kosmidis, G. Baio, M. Cucuringu, F. Kiraly, G. Whitaker, "Modelling Outcomes of Soccer Matches", accepted to *Machine Learning Journal* (2018)

TEACHING EXPERIENCE

University of Oxford

- Instructor: Probability and Statistics for Network Analysis, Department of Statistics, 2018 (50%, joint with Gesine Reinert 50%), 2017 (25%, joint with Gesine Reinert 75%)

UCLA

- Instructor: MATH 3C Ordinary Differential Equations with Linear Algebra for Life Sciences Students, MATH 3C, Department of Mathematics (Spring 2016)
- Instructor: MATH 191 Topics in Data Science: Algorithms and Mathematical Foundations, Department of Mathematics (newly developed course, Fall 2015)
- Instructor: MATH 191 Graphs and Networks, Department of Mathematics (newly developed course, Winter 2015)
- Instructor: MATH 174 Mathematics of Finance, Department of Mathematics (Spring 2014)
- Instructor: MATH 3C Probability for Life Sciences Students, Department of Mathematics (Fall 2013)

Princeton University

- Instructor: MAT 308 Theory of Games, Department of Mathematics & Economics (Spring 2011)
- Teaching Assistant: MAT 307 Graph Theory, Paul Seymour (Spring 2009)
- Teaching Assistant: MAT 306 Combinatorics, Jan Vondrak (Spring 2008)

ASSESSMENT

- Assessor for Part B Mathematical Extended Essay, Mathematical Institute, University of Oxford, 2018

RESEARCH EXPERIENCE

Visiting researcher INRIA, Paris, France (March - April 2015). Host: Alexandre d'Aspremont, École Normale Supérieure

Research Fellow Simons Fellow, Simons Institute for Theoretical Computing, University of Berkeley, USA (Aug-Dec 2014), *Algorithmic Spectral Graph Theory* semester-long program

Participant AMS Mathematics Research Community, *Algebraic and Geometric Methods in Applied Discrete Mathematics*, Group: *Combinatorics in Molecular Biology*, Snowbird, Utah, June 2014

Research Fellow ICERM, Brown University, USA (Spring 2014), *Network Science and Graph Algorithms* semester program

Visiting researcher Mathematical Institute, Oxford, UK (January 2014), working with Radek Erban

Visiting student Oxford Centre for Collaborative Applied Mathematics, Oxford, UK (March-April 2012), *Detecting slow variables in dynamic data via anisotropic diffusion maps* (with Radek Erban); *Core-periphery structure in networks* (with Mason Porter)

Visiting student University of Louvain-la-Neuve, Belgium (May-June 2010), *Large Graphs and Networks Research Group*. Advisors: Vincent Blondel and Paul Van Dooren

Summer Research Assistant Princeton University, NJ, Advisors: Robert Calderbank (2008), Amit Singer (2009, 2010, 2011)

Research Assistant Dept. of Mathematical Sciences, University of North Carolina, NC (Summer 2006), *Algorithmic Combinatorics on Words, Primitive Partial Words*. Advisor: Francine Blanchet-Sadri

Research Experience for Undergraduates (REU) Dept. of Mathematics, Cornell University, Ithaca, NY (Summer 2005), *Analysis on Fractals*. Advisor: Robert Strichartz

Computer Science Undergraduate Thesis Hiram College (Spring 2006), Artificial Intelligence: *Automated Search for Numerical Solutions to Number Theory Problems*.

Economics Undergraduate Thesis Hiram College (Spring 2007), *Derivatives in Financial Markets*.

SUPERVISION AND MENTORING

Postdoctoral researchers (Alan Turing Institute):

- Andrew Elliott (Aug. 2017 - present), *Anomaly detection in networks with applications to fraud detection (Accenture grant)*
- Andrea Pizzoferrato, (Nov. 2017 - present), *Predictive graph analytics and propagation of information in networks*
- Luis Ospina (Oct. 2017 - June 2018), *Anomaly detection in networks via nonlinear dimensionality-reduction*

Graduate students - PhD interns (Alan Turing Institute):

- Peter Davies & Aldo Glielmo, *Clustering signed networks and time series data*, Summer 2018 (joint with Hemant Tyagi)
- Oliver Crook & Tim Hurst, *Design, analysis and applications of efficient algorithms for graph based modelling*, Summer 2018 (joint with M. Thorpe, K. Zygalakis, C.-B. Schonlieb, E. Soilleux)

- Yoni Dukler, visiting PhD student from UCLA Department of Mathematics (July-August 2018)

Graduate students (Oxford):

- Pawel Bednarek, MSc in Statistics (2018), *Statistical analysis of the US production network and simulation of its resistance to exogenous shocks* (ongoing)
- Angus Chiu, MSc in Statistics, Distinction (2017), *Detection of Core-Periphery Structure in Directed Networks* (with G. Reinert)
- Darrell Tse, MSc in Computational Finance, with Distinction (2017) (Mathematical Institute), *Extracting partial rankings from multivariate time series data* (joint with Sam Howison)

Graduate students (UCLA, mentored PhD students of Andrea Bertozzi):

- Joseph Woodworth: “Ordinal Embedding Of Unweighted Knn Graphs Via Synchronization”, IEEE Machine Learning for Signal Processing Workshop (MLSP), 2015
- Charlie Marshak: “Rank Aggregation for Course Sequence Discovery”, Complex Networks 2017

Undergraduate students (UCLA):

- Boya Song: Algorithms for clustering signed graphs (2015)
- Jack Zhang: Algorithms for graph matching and role similarity in networks (Spring 2015)
- Sharon Xu: Nonlinear dimensionality reduction for imbalanced classification (Fall 2015)

GRANTS AND INDUSTRY FUNDING

- Imperial-Thomson Reuters Data Science Grant Call, *Predictive graph analytics and impact of news information in networks*, 2018-2019. Grant value: £100,000 (co-PI)
- Alan Turing Institute, *Discovering polarity change via constrained clustering on large-scale web archives*, (seed funding) 2018. Grant value: £14,583 (co-PI)
- Accenture and Turing alliance for Data Science, *Network analysis for fraud detection*, 2017-2020. Grant value: £426,000 (PI)
- Alan Turing Institute, small groups funding to host Guillaume Lécué, November 2017. Grant value: £1,000
- Alan Turing Institute, *Predictive graph analytics and propagation of information in networks* (seed funding) November 2017-April 2018. Grant value: £30,375
- Alan Turing Institute, small groups funding to host Sanjay Chawla and Yiannis Koutis, November 2017. Grant value: £3,420
- Alan Turing Institute, *Anomaly detection in networks via nonlinear dimensionality-reduction*, (seed funding), October 2017-March 2018. Grant value: £22,700
- Lloyd’s Register Foundation, *Decomposing low-dimensional structure and detecting anomalies from incomplete data*, 2017 (with A. Eftekhari, J. Tanner, and H. Tyagi). Grant value: £46,900
- Alan Turing Institute Research Fellowship Grant, 2017-2020. Grant value: £191,000
- AMS Simons Travel Grant, 2014-2016. Grant value: \$4,000

ACCOMPLISHMENTS

- Princeton University Graduate School Fellowship (2007-2008)
- Princeton University Starr Fellowship (2007-2008)
- Honorable Mention at the Computing Research Association’s Undergraduate Awards (2007)
- Departmental Awards: Mathematics (2005, 2006), Computer Science (2005)
- Top 9% at the Putnam Mathematics Competition (2004)
- First place at the ECC Mathematics Competition (2005, 2006)
- Global Trustee Scholarship (2003-2007)
- Phi Beta Kappa; Alpha Honor Society (2004-2007); Dean’s List (2003-2007)

INVITED TALKS

2017-2018

- The Statistical Seminar, CREST (Center for Research in Economics and Statistics), Paris, June 2018
- University of Edinburgh, LFCS Seminar, School of Informatics, May 2018
- Complex Networks 2017, Lyon, November 2017
- University of Bath, Conference on Scientific Computation and Differential Equations (SciCADE 2017), mini-symposium talk in the session "Nonlocal partial differential equations and graph-based techniques for imaging", September 2017
- Applied Stochastic Models & Data Analysis (ASMDA 2017), "Optimization for machine learning" session, London, June 2017
- University of Bucharest, Conference on Recent Advances in Artificial Intelligence, RAAI 2017, June 2017
- University of Cambridge, Statistics Seminar, Cambridge, May 2017
- University of Warwick, Partial Differential Equations for Large Data, Workshop, May 2017
- Optimization and Statistical Learning, Workshop, Les Houches, France, April 2017
- University College London, Statistical Science Seminar, March 2017
- Alan Turing Institute, Fellow Short Talks, Feb 2017
- Alan Turing Institute, Turing meets Crick Event
- University of Oxford, Numerical Analysis Seminar, January 2017

2010 - 2016

- SIAM Conference on Uncertainty Quantification, minisymposium "Model reduction in stochastic dynamical systems", EPFL, Lausanne, Switzerland, April 2016
- University of Bucharest, Faculty of Mathematics and Computer Science, January 2016
- UCLA, Level Set Collective, Host: Prof. S. Osher, April 2015
- INRIA, Paris, SIERRA Seminar, Host: A. d'Aspremont, March 2015
- Harvard University, School of Engineering and Applied Sciences (SEAS), February 2014
- Brown University, Institute for Computational and Experimental Research in Mathematics (ICERM), Research Cluster on *Geometric analysis methods for graph algorithms*, February 2014
- University of Oxford, Wolfson Centre for Mathematical Biology, January 2014
- AMS Western Sectional Meeting on "Computational Problems on Large Graphs and Applications", University of California Riverside, November 2013
- University of Oxford, Oxford Centre for Collaborative Applied Mathematics (OCCAM), February 2012
- University of Oxford, CABDyN Complexity Centre, Networks Journal Club, April 2012
- Princeton University, Special Graduate Student PACM Colloquium, March 2010

SKILLS

- Programming languages: MATLAB, R, Maple, Python, C, Java
- Languages: Romanian (Native), English (Fluent), French (Good)

SERVICE

Journal & Conference Reviewer

- SIAM Journal of Applied Mathematics
- SIAM Multiscale Modeling and Simulation
- SIAM Journal on Mathematics of Data Science
- Journal of Machine Learning Research (JMLR)
- Proc. of the National Academy of Sciences (PNAS)
- Science Advances
- Scientific Reports (Nature)
- Computational Learning Theory (COLT)
- Applied and Computational Harmonic Analysis
- European Journal of Applied Mathematics
- Discrete & Computational Geometry
- Optimization Letters
- Applied Network Science
- IEEE Signal Processing Letters
- IEEE Transactions on Signal Processing
- IEEE Transactions on Network Science and Engineering

- IEEE Transactions on Knowledge and Data Engineering
- IEEE Transactions on Wireless Communications
- IEEE Control Systems Letters
- Intl. Journal of Foundations of Computer Science
- Systems & Control Letters
- Physica A
- Computation
- Ad Hoc Networks
- Plos One

Reviewer

- National Science Foundation (NSF) Panel - Grant Reviewer, Alexandria, VA, 2018
- Enrichment Ph.D. student applications, Alan Turing Institute, 2017-2018

Organizer

- Organizer & session chair within the cluster "*Learning: Machine Learning, Big Data, Cloud Computing, and Huge-Scale Optimization*", 23rd International Symposium on Mathematical Programming (ISMP 2018), Bordeaux, France, July 2018

Program Committee

- (upcoming) Seventh Workshop on Complex Networks and their Applications, Cambridge, 2018
- Sixth Workshop on Complex Networks and their Applications, Lyon, 2017
- Fifth Workshop on Complex Networks and their Applications, Milan, 2016

ACTIVITIES

- Co-organizer of the "*Theory and Algorithms for Data Science*" (TADS) Seminar, Alan Turing Institute, 2017-present
- Turing Interest Group on "*Data science for sports, activity, and well-being*" (founding member)
- Coordinator for the research interest group "*Heterogeneous data: models and algorithms*", Alan Turing Institute, 2017
- Organizer of the Applied Math Student Seminar, Princeton University (2009-2011)
- Graduate Social Chair, Romanian Students and Scholars Association at Princeton (2007)

CONFERENCES, WORKSHOPS AND SUMMER SCHOOLS ATTENDED

- Workshop on Finance, Insurance, Probability and Statistics (FIPS), King's College, London, September 2018
- KDD 2018 - ACM SIGKDD International Conference on Knowledge Discovery and Data Mining, London, August 2018
- International Symposium on Mathematical Programming (ISMP 2018), Bordeaux, July 2018 (session organizer)
- Big Data in Financial Markets, Trinity College, University of Cambridge, May 2018
- AISTATS 2018, Lanzarote, Spain, April 2018 (paper & poster)
- Workshop on Data Science Theory and Practice, London School of Economics, March 2018
- Statistics of geometric features and new data types, Cambridge, March 2018
- COSTNET Meeting, Department of Statistics, University of Oxford, March 15-16, 2018
- Complex Networks 2017, Lyon, November 2017
- University of Bath, Conference on Scientific Computation and Differential Equations (SciCADE 2017)
- Turing Challenges Workshop, Alan Turing Institute, August 2017
- 3rd UCL Workshop on the Theory of Big Data, June 2017
- Recent Advances in Artificial Intelligence, RAAI 2017, Bucharest, June 2017
- Cambridge Networks Day, Cambridge, June 2017
- High Dimensional Mathematics - A Research Conference of the Cantab Capital Institute for the Mathematics of Information, Cambridge, May 2017
- University of Warwick, Partial Differential Equations for Large Data, Workshop, May 2017
- Optimization and Statistical Learning, OSL 2017, Les Houches, France, April 2017
- SIAM Conference on Uncertainty Quantification, invited talk, in the minisymposium "Model reduction in stochastic dynamical systems", EPFL, Lausanne, Switzerland, April 2016
- Analysis and Control of Network Dynamics, Institute for Mathematics and its Applications, Univ. of Minnesota, October 2015
- Conference on Big Data, Center of Mathematical Sciences and Applications, Harvard University, August 2015

- Groups and interactions in data, networks and biology, Dept. of Mathematical Sciences, Carnegie Mellon Univ., May 2015
- Structural Inference in Statistics, Spring School, Sylt, Germany, March 2015
- Big Data Finance Workshop, Courant Institute, New York University, March 2015
- AMS Joint Mathematics Meetings, San Antonio, Jan 2015
- Graph Limits, Groups and Stochastic Processes Summer School, Budapest, Hungary, June 2014
- Workshop on Topology and Geometry of Networks and Discrete Metric Spaces, Institute for Mathematics and its Applications, University of Minnesota, April 2014
- Semidefinite Programming and Graph Algorithms, ICERM, Brown University, February 2014
- 10th Workshop on Algorithms and Models for the Web Graph (WAW 2013), Harvard University, December 2013
- Succinct Data Representations and Applications, Simons Institute for the Theory of Computing, September 2013
- COLT, Conference on Learning Theory, Princeton University, June 2013
- IMA Workshop, Large Graphs: Modeling, Algorithms and Applications, Univ. of Minnesota, Oct. 2011
- Computational Aspects - Biomolecular NMR, May 2011, Lucca (Barga), Italy (poster)
- SAMSI Complex Networks Tutorials and Opening Workshop, RTP, NC, August 2010 (poster)
- International Summer School on Algorithmic Game Theory, Fudan University, Shanghai, July 2010
- Combinatorics: Methods and Applications in Mathematics and Computer Science, Workshop I: Probabilistic Techniques and Applications, IPAM UCLA, October 2009
- Theory and Practice of Computational Machine Learning, Summer School, Univ. of Chicago, June 2009
- DIMACS Workshop on Graph Coloring and Structure, Princeton University, May 2009

REFERENCES

Andrea Bertozzi

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University of California Los Angeles (UCLA), (310)-825-4340,
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Robert Calderbank

Professor, Department of Computer Science, Mathematics, and Electrical and Computer Engineering
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Amit Singer (Ph.D. Advisor)

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Jared Tanner

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