Mihai Cucuringu

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EMPLOYMENT

University of Oxford and Alan Turing Institute Oxford/London

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

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 science, and certain computationally-hard inverse problems on large graphs with applications to various problems in machine learning, statistics, finance, engineering, and biology

- graph algorithms and applications
- spectral and semidefinite programming algorithms, group synchronization, ranking, clustering, low-rank matrix completion
- analysis of large data sets, nonlinear dimensionality reduction and diffusion maps, intrinsic slow variables in dynamic data
- networks (signed, multiplex, temporal), community and core-periphery structure
- statistical analysis of big financial data, statistical arbitrage, market microstructure, limit order books, risk models
- 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, C. Marshak, D. Montag, P. Rombach, "Rank Aggregation for Course Sequence Discovery in Educational Data", Complex Networks 2017
2. 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)
3. 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, "On denoising modulo 1 samples of a function", arXiv: 1710.10210 (2017)
2. A. Tsokos, S. Santhosh, I. Kosmidis, G. Baio, M. Cucuringu, F. Kiraly, G. Whitaker, "Modelling of Outcomes of Soccer Matches" (2017)

Teaching Experience

University of Oxford

- Instructor: Probability and Statistics for Network Analysis, Department of Statistics, 2017 (joint with Gesine Reinert)

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)

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)*
- Luis Ospina (Oct. 2017 - present), *Anomaly detection in networks via nonlinear dimensionality-reduction*
- Andrea Pizzoferrato, (Nov. 2017 - present), *Predictive graph analytics and propagation of information in networks*

Graduate students (Oxford):

- Angus Chiu, MSc in Statistics, with Distinction (2017), *Detection of Core-Periphery Structure in Directed Networks* (joint with Gesine 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

- Accenture and Turing alliance for Data Science, *Network analysis for fraud detection* (PI)
- 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 award to host two visitors, 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)

- 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

- 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
- 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 Reviewer:

- SIAM Journal of Applied Mathematics
- Proceedings of the National Academy of Sciences (PNAS)
- European Journal of Applied Mathematics
- Discrete & Computational Geometry
- International Journal of Foundations of Computer Science
- IEEE Signal Processing Letters
- IEEE Transactions on Signal Processing
- IEEE Transactions on Network Science and Engineering
- IEEE Transactions on Wireless Communications
- IEEE Transactions on Knowledge and Data Engineering
- Systems & Control Letters
- Physica A
- Ad Hoc Networks
- Plos One

Program Committee:

- Sixth Workshop on Complex Networks and their Applications, Lyon, 2017
- Fifth Workshop on Complex Networks and their Applications, Milan, 2016

Reviewer:

- 2017 Enrichment Ph.D. student applications, Alan Turing Institute, March 2017

ACTIVITIES

- Co-organizer of the *"Theory and Algorithms for Data Science" (TADS)* Seminar, Alan Turing Institute, 2017
- 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

- 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
- Workshop on Geometry and Algorithms, Princeton University, Oct 2008
- Princeton-Oxford Graph Theory Workshop, Oxford, England, June 2008
- International Conference on Automata, Languages and Related Topics, Debrecen, Hungary, Oct. 2008 (paper)
- IEEE Symposium on Foundations of Computer Science (FOCS), Berkeley, October 2006
- Second Conference on Analysis and Probability on Fractals, Cornell University, June 2005

REFERENCES

Andrea Bertozzi
Professor, Department of Mathematics, Director of Applied Mathematics
University of California Los Angeles (UCLA), (310)-825-4340, bertozzi@math.ucla.edu

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Professor, Department of Computer Science, Mathematics, and Electrical and Computer Engineering
Duke University, (919) 668-2728, robert.calderbank@duke.edu

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Amit Singer (**Ph.D. Advisor**)
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