Boris V. Brimkov

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EDUCATION

- Ph.D. Computational and Applied Mathematics, Rice University, 8/2017 NSF Graduate Research Fellowship Thesis: Graph Coloring, Zero Forcing, and Related Problems; advisor: Illya V. Hicks
- **M.A.** Computational and Applied Mathematics; Rice University 12/2015 Thesis: *Efficient Computation of Chromatic and Flow Polynomials*; advisor: Illya V. Hicks
- **B.S.** Mathematics, University at Buffalo, 06/2012 NSF CSUMS Fellowship Budapest Semesters in Mathematics, Hungary, Spring 2012

PROFESSIONAL EXPERIENCE

- Postdoctoral Fellow Rice Academy of Fellows, Rice University; Fall 2017 present
- Teaching Assistant Rice University; Spring 2014 Spring 2015, Spring 2016, Spring 2017
- Adjunct Instructor SUNY Fredonia; Fall 2012 Spring 2013
- Student Researcher NSF CSUMS program, University at Buffalo; Spring 2011 Fall 2011
- Mentor/Grader Gifted Math Program, University at Buffalo; Fall 2009 Fall 2010

RESEARCH INTERESTS

Graph theory, combinatorial optimization, discrete geometry, computational complexity, algorithm design, mathematical modeling, data science, mathematics education

PUBLICATIONS

Peer-reviewed journal publications

- 14) K. Boyer, B. Brimkov, S. English, D. Ferrero, A. Keller, R. Kirsch, M. Phillips, C. Reinhart. The zero forcing polynomial of a graph. *Discrete Applied Mathematics* (in press) (2018).
- 13) B. Brimkov, C.C. Fast, I.V. Hicks. Computational approaches for zero forcing and related problems. *European Journal of Operational Research* (in press) (2018).
- 12) A. Abiad, B. Brimkov, X. Martinez-Rivera, S. O, J. Zhang. Spectral bounds for the connectivity of regular graphs with given order. *Electronic Journal of Linear Algebra* 34: 428-443 (2018).
- 11) C. Bozeman, B. Brimkov, C. Erickson, D. Ferrero, M. Flagg, L. Hogben. Restricted power domination and zero forcing problems. *Journal of Combinatorial Optimization* (in press) (2018).
- 10) J. Breen, B. Brimkov, J. Carlson, L. Hogben, K.E. Perry, C. Reinhart. Throttling for the game of Cops and Robbers on graphs. *Discrete Mathematics* 341(9): 2418-2430 (2018).
- 9) D. Amos, J. Asplund, B. Brimkov, R. Davila. The sub-*k*-domination number of a graph with applications to *k*-domination. *Discussiones Mathematicae Graph Theory* (in press) (2018).
- 8) B. Brimkov, I.V. Hicks. Complexity and computation of connected zero forcing. *Discrete Applied Mathematics* 229(1): 31-45 (2017).

- 7) B. Brimkov, J. Edmond, R. Lazar, B. Lidický, K. Messerschmidt, S. Walker. Injective choosability of subcubic planar graphs with girth 6. *Discrete Mathematics* 340(10): 2538-2549 (2017).
- 6) A. Abiad, B. Brimkov, A. Erey, L. Leshock, X. Martínez-Rivera, S. O, S.-Y. Song, J. Williford. On the Wiener index, distance cospectrality and transmission regular graphs. *Discrete Applied Mathematics* 230: 1-10 (2017).
- 5) R.P. Barneva, K. Kanev, B. Kapralos, M. Jenkin, B. Brimkov. Integrating technology-enhanced collaborative surfaces and gamification for the next generation classroom. *Journal of Educational Technology Systems* 45(3): 309-325 (2017).
- 4) B. Brimkov, I.V. Hicks. Chromatic and flow polynomials of generalized vertex join graphs and outerplanar graphs. *Discrete Applied Mathematics* 204: 13-21 (2015).
- 3) B. Brimkov, I.V. Hicks. Memory efficient algorithms for cactus graphs and block graphs. *Discrete Applied Mathematics* 216(2): 393-407 (2015).
- 2) B. Brimkov. Geometric approach to string analysis for biosequence classification. *Journal of Integrative Bioinformatics* 11(3): 252 (2014).
- 1) V.E. Brimkov, R.P. Barneva, B. Brimkov. Connected distance-based rasterization of objects in arbitrary dimension. *Graphical Models* 73(6): 323-334 (2011).

Accepted journal publications pending revision

1) B. Brimkov, D. Mikesell, L. Smith. Connected power domination in graphs. *Journal of Combinatorial Optimization* (2018).

Peer-reviewed conference publications

- 7) B. Brimkov. On sets of line segments featuring a cactus structure. In: *IWCIA 2017, Lecture Notes in Computer Science, Springer,* Vol. 10256: 30-39 (2017).
- 6) B. Brimkov, V.E. Brimkov. Geometric approach to biosequence analysis. In: *PACBB 2014, Advances in Intelligent Systems and Computing, Springer*, Vol. 294: 97-104 (2014).
- 5) B. Brimkov. Memory efficient shortest path algorithms for cactus graphs. In: *ISVC 2013, Lecture Notes in Computer Science, Springer*, Vol 8033: 476-485 (2014).
- 4) B. Brimkov, J.-H. Jung, J. Kotary, X. Liu, J. Zheng. A spectral and radial basis function hybrid method for visualizing vascular flows. In: *CompIMAGE 2012, CRC Press, Taylor & Francis:* 205-208 (2012).
- 3) K. Kanev, N. Mirenkov, B. Brimkov, K. Dimitrov. Semantic surfaces for business applications. In: *Software, Services, and Semantic Technologies, Demetra Publ.*: 36-43 (2009).
- 2) V.E. Brimkov, R.P. Barneva, B. Brimkov. Minimal offsets that guarantee maximal or minimal connectivity of digital curves in nD. In: *DGCI 2009, Lecture Notes in Computer Science, Springer,* Vol. 5810: 337-349 (2009).
- 1) V.E. Brimkov, R.P. Barneva, B. Brimkov, F. de Vieilleville. Offset approach to defining 3D digital lines. In: *ISVC 2008, Lecture Notes in Computer Science, Springer*, Vol. 5358: 678-687 (2008).

Submitted papers

- 8) B. Brimkov, K. Duna, L. Hogben, K. Lorenzen, C. Reinhart, S.-Y. Song, M. Yarrow. Graphs that are cospectral for the distance Laplacian *arXiv: 1812.05734* (2018).
- 7) A. Abiad, B. Brimkov, A. Chan, A. Grigoriev. On the status sequences of trees. *arXiv:1812.03765* (2018).
- 6) B. Brimkov, J. Carlson, I.V. Hicks, R. Patel. Power domination throttling. *arXiv:1810.01009* (2018).
- 5) B. Brimkov, J. Geneson, A. Jensen, J. Miller, P.S. Nowbandegani. Intersections, circuits, and colorability of line segments. *arXiv:1808.07176* (2018).
- 4) B. Brimkov, R. Patel, V. Suriyanarayana, A. Teich. Power domination polynomials of graphs. *arXiv:1805.10984* (2018).
- 3) B. Brimkov, V.E. Brimkov. Optimal conditions for connectedness of discretized sets. *arXiv*:1808.03053 (2018).

- 2) B. Brimkov, C.C. Fast, I.V. Hicks. Graphs with extremal connected forcing numbers. *arxiv:* 1701.08500 (2017).
- 1) B. Brimkov, R. Davila. Characterizations of the connected forcing number of a graph. *arXiv:* 1604.00740 (2016).

Educational contributions, editorials, technical reports

- 5) E. Fokoué, B. Brimkov. The multifaceted impact of statistical methodology and theory in data science (Editorial Note). *Mathematics for Applications* 7(1): 1-2 (2018)
- 4) B. Brimkov, I.V. Hicks. On the logspace shortest path problem. *Electronic Colloquium on Computational Complexity (ECCC)* 23:3 (2016).
- 3) B. Brimkov. Emphasizing space efficiency in a computer science curriculum. *ACM Journal of Computing Sciences in Colleges*, 31(6): 55-57 (2016).
- 2) B. Brimkov. A note on the clique number of complete *k*-partite graphs. *arXiv:* 1507.01613 (2015).
- 1) R.P. Barneva, B. Brimkov. How computer science develops mathematical skills. *ACM Journal of Computing Sciences in Colleges*, 26(6): 170-172 (2011).

PRESENTATIONS AND WORKSHOPS

Invited presentations

- 1) "Catching a robber quickly with few cops", INFORMS 2018 Annual Meeting, Session on Combinatorial Optimization over Graphs, Phoenix, AZ, Nov 2018.
- 2) "The zero forcing polynomial of a graph", SIAM Conference on Discrete Mathematics 2018, Minisymposium on Results from the Graduate Research Workshop in Combinatorics, University of Colorado Denver, Denver, CO, June 2018.
- "Spectral bounds for the connectivity of regular graphs with given order", Joint Math Meetings 2018, AMS Special Session on Research from the Rocky Mountain-Great Plains Graduate Research Workshop in Combinatorics, San Diego, CA, Jan 2018.
- 4) "Zero forcing and related problems", Discrete Mathematics Seminar, University of Delaware, Newark, DE, Nov 2017.
- 5) "Redistricting with optimal minority representation", INFORMS 2017 Annual Meeting, Session on Combinatorial Optimization and Applications, Houston, TX, Oct 2017.
- 6) "Zero forcing and related problems", Mathematics and Statistics Colloquium, University of Houston-Downtown, Houston, TX, Oct 2017.
- 7) "Connected zero forcing", 2017 Meeting of the International Linear Algebra Society, Mini-symposium on Zero Forcing: Its Variations and Applications, Iowa State University, Ames, IA, July 2017.
- 8) "Zero forcing and related problems", CAAM Graduate Recruitment Event, Rice University, Houston, TX, Feb 2017.
- 9) "Connected zero forcing of a graph", INFORMS 2016 Annual Meeting, Session on Stable Sets, Zeroforcing Sets, and Target Sets in Graphs, Nashville, TN, Nov 2016.
- 10) "On the Connected Forcing Number of a Graph", Discrete Mathematics Seminar, Texas State University, San Marcos, TX, Oct 2016.
- 11) "On the connected forcing number of a graph", Computer Science Graduate Seminar, Rice University, Houston, TX, Oct 2016.
- 12) "Redistricting with optimal minority representation", Computational and Applied Mathematics Homecoming Alumni Reunion, Rice University, Houston, TX, Oct 2016.
- 13) "Structural and extremal results on connected zero forcing", AMS Sectional Meeting, Special Session on Recent Advances in Structural and Extremal Graph Theory, Denver, CO, Oct 2016.
- 14) "Space efficient algorithms for large scale graph problems", ACM Richard Tapia Celebration of Diversity in Computing Conference, Doctoral Consortium, Austin, TX, Sept 2016.

- 15) "Logspace shortest path algorithms", Computer Science Graduate Seminar, Rice University, Houston, TX, Nov 2015.
- 16) "Efficient computations of certain graph polynomials", Seminar of Algebra Department, University of Sofia St. Kliment Ohridski, Sofia, Bulgaria, June 2015.

Contributed presentations

- 1) "Intersections, circuits, and colorability of line segments", MMMM Combinatorics Conference, Iowa State University, Ames, IA, Sept 2018.
- 2) "Connected power domination in graphs", CombinaTexas 2018, Texas A&M University, College Station, TX, Feb 2018.
- 3) "On sets of line segments featuring a cactus structure", International Workshop on Combinatorial Image Analysis, Plovdiv, Bulgaria, June 2017.
- 4) "Redistricting with optimal minority representation", Computational and Applied Mathematics Graduate Seminar, Rice University, Houston, TX, Nov 2016.
- 5) "Emphasizing space efficiency in a computer science curriculum" (poster), Consortium for Computing Sciences in Colleges, Hamilton College, Clinton, NY, Apr 2016.
- 6) "Efficient computation of chromatic and flow polynomials", INFORMS Annual Meeting, Philadelphia, PA, Nov 2015.
- 7) "A space-efficient shortest path algorithm for block graphs", Computational and Applied Mathematics Graduate Seminar, Rice University, Houston, TX, Sept 2015.
- 8) "Chromatic and flow polynomials of generalized vertex join graphs and outerplanar graphs", Computational and Applied Mathematics Graduate Seminar, Rice University, Houston, TX, Mar 2015.
- 9) "Geometric approach to string analysis", Computational and Applied Mathematics Graduate Seminar, Rice University, Houston, TX, Oct 2013.
- 10) "A novel hybrid method and library interpolation for rapid CFD of vascular flows" (poster), Council on Undergraduate Research Posters on the Hill, Washington DC, Apr 2012.
- 11) "Optimizing the performance of a hybrid method for numerically solving and visualizing vascular flows" (poster), Laurier Centennial Conference: Applied Mathematics, Modeling, and Computer Science, Waterloo, Canada, July 2011.
- 12) "Proposing a hybrid method to simulate irregular vascular flows", Mathematical Developments and Applications: Radial Basis Functions, UMass Dartmouth, Dartmouth, MA, June 2011.
- 13) "Offset approach to defining 3D digital lines", International Symposium on Visual Computing, Las Vegas, NV, Dec 2008.

Sponsored workshops

- 1) Graduate Research Workshop in Combinatorics, Ames, IA, May 2018. Presented "Some problems related to sets of line segments"
- 2) Geometry of Redistricting and Gerrymandering Workshop, University of Texas at Austin, Austin, TX, Feb 2018. Presented "Districting heuristics"
- 3) Graduate Research Workshop in Combinatorics, Denver, CO, July 2017. Presented "Counting the number of distinct zero forcing sets of graphs"
- 4) AIM Workshop on Zero Forcing and its Applications, San Jose, CA, Jan 2017.
- 5) Graduate Research Workshop in Combinatorics, Laramie, WY, July 2016. Presented "Characterizing chromatic and flow polynomials of graphs"
- 6) Summer School on Image Processing, Vienna, Austria, July 2012. Presented "2D modality classification"

TEACHING EXPERIENCE

Instructor on record

- Applied Discrete Optimization (graduate course); Rice University, Spring 2019
- Graph Theory (graduate course); Rice University, Spring 2018
- Discrete Mathematics for Computer Science; SUNY Fredonia, Spring 2013
- Web Programming; SUNY Fredonia, Spring 2013 (two sections)
- Web Programming; SUNY Fredonia, Fall 2012 (two sections)

Students advised in independent research

- Derek Mikesell (graduate), Logan Smith (graduate); worked on "Connected power domination in graphs" and "Computational approaches for zero forcing and power domination"; Rice University, 2017-2018
- Seth Kimmel (undergraduate); worked on "Efficient heuristics for cryptocurrency arbitrage"; Rice University, 2018
- Rutvik Patel (undergraduate), Varun Suriyanarayana (undergraduate), Alexander Teich (graduate); worked on "Power domination polynomials of graphs"; Rice University, 2018
- Jonathan Celaya (undergraduate); worked on "Efficient algorithms for inverse graph problems"; Rice University, 2017-2018
- Nick Bell (graduate), Nathaniel Kroeger (graduate), Seth Brown (graduate); worked on "Efficient computation for restricted power domination and zero forcing"; Rice University, 2018
- Rebecca Francis (undergraduate); worked on "Combinatorial optimization heuristics for redistricting"; Rice University, 2018

Teaching assistant

- Introduction to Linear and Integer Programming; Rice University, Spring 2017
- Introduction to Linear and Integer Programming; Rice University, Spring 2016
- Introduction to Linear and Integer Programming; Rice University, Spring 2015
- Introduction to Computational Engineering; Rice University, Fall 2014
- Introduction to Computational Engineering; Rice University, Spring 2014

Grader

- Introduction to Optimization; Rice University, Fall 2015
- Matrix Analysis; Rice University, Fall 2013
- Logic and Sets; Gifted Math Program, University at Buffalo, Fall 2010
- Introduction to Logic; Gifted Math Program, University at Buffalo, Fall 2009 Spring 2010

SCHOLARSHIPS AND AWARDS

•	SIAM DM18 Early Career Award, 2018	\$650
•	Graduate Research Workshop in Combinatorics travel grant, 2018	\$400
•	CombinaTexas'18 travel grant, Texas A&M University, 2018	\$100
•	Geometry of Redistricting workshop travel grant, University of Texas at Austin, 2018	\$500
•	Alan Weiser Memorial Travel Award, Rice University, 2017	\$600
•	Graduate Research Workshop in Combinatorics travel grant, 2017	\$400
•	AIM Workshop on Zero Forcing and its Applications travel grant, 2017	\$700
•	Richard Tapia Celebration of Diversity in Computing Doctoral Consortium Scholarship, 2016	\$500
•	Graduate Research Workshop in Combinatorics travel grant, 2016	\$400
•	NSF Graduate Research Fellowship 2014-2017	\$138,000

•	George R. Brown Scholarship, Rice University, 2013	\$25,000
•	SSIP2012 travel grant, Vienna, Austria, 2012	\$400
•	NSF CSUMS fellowship, URGE to Compute, University at Buffalo, 2011	\$10,000
•	Provost Scholarship, University at Buffalo, 2009-2012	\$9,000
•	UUP Benefit Trust Fund Scholarship, 2009-2012	\$4 <i>,</i> 500
•	David Matthew Robinson Scholarship, 2009	\$1,000
		Total: \$192,450

PROFESSIONAL SERVICE

Department and University service

- INFORMS student chapter officer; Rice University Spring 2017
- Judge for Rice Undergraduate Research Symposium; Rice University Spring 2016
- CAAM graduate seminar organizer; Rice University Fall 2015, Spring 2016
- SIAM student chapter officer; Rice University Fall 2014, Spring 2015
- CAAM pre-colloquium organizer; Rice University Fall 2013, Spring 2014
- Webmaster; SUNY Fredonia Computer Science Department Fall 2012

Conference organization

- IWCIA'17 program committee member; Sofia, Bulgaria June 2017
- CompIMAGE'16 program committee member; Niagara Falls, NY Sept 2016
- PACBB'16 program committee member; University of Seville, Spain June 2016
- INFORMS 2015 Annual Meeting session chair of Networks and Graphs I; Philadelphia, PA Nov 2015
- PACBB'15 scientific committee member; University of Salamanca, Spain June 2015
- IWCIA'12 organizing committee member; University of Austin, TX Nov 2012
- CompIMAGE'10 organizing committee member; Buffalo, NY April 2010

Journal editing

• Guest editor of Mathematics for Applications 7(1), 2018 (with E. Fokoué)

Reviewer for:

IISE Transactions (Taylor&Francis Online); Linear and Multilinear Algebra (Taylor&Francis Online); Journal of Combinatorial Optimization (Springer); Journal of Applied Mathematics and Computing (Springer); Discrete Applied Mathematics (Elsevier); INFORMS Journal on Optimization (INFORMS); Theory and Applications of Graphs; Discrete Mathematics (Elsevier); Discrete Mathematics, Algorithms and Applications; Australasian Journal of Combinatorics; Discrete Dynamics in Nature and Society; International Workshop on Combinatorial Image Analysis; International Conference on Practical Applications of Computational Biology & Bioinformatics; International Symposium on Visual Computing; International Conference on Software, Services, and Semantic Technologies

Professional society membership

- Institute for Operations Research and the Management Sciences (INFORMS)
- Society for Industrial and Applied Mathematics (SIAM)

COMPUTER SKILLS

Programming languages: C/C++, Matlab, Mathematica, Sage, Julia, Python HPC experience: MPI, OpenMP, OpenCL, CUDA, OCCA Systems and libraries: Gurobi, Microsoft Excel, Subversion, Inkscape, Paraview, Audacity Scripting languages: Latex, HTML, CSS, Javascript