Nathaniel Karst

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Somerville, MA 02143
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EDUCATION

Ph.D. in Applied Mathematics, August 2011
Cornell University, Ithaca, NY
Dissertation: Combinatorial Designs for Key Distribution and Secure Re-keying in Group Communication Systems
Adviser: Stephen B. Wicker

B.S. in Electrical and Computer Engineering, May 2007
Franklin W. Olin College of Engineering, Needham, MA

EXPERIENCE

Assistant professor of applied mathematics — Sep. 2011 – present
Division of Mathematics and Science
Babson College, Wellesley, MA

Visiting research assistant — Sep. 2010 – Dec. 2010
Advanced Technology Research Group
Research In Motion, Rolling Meadows, IL

Visiting research assistant — May 2009 – Aug. 2009
Department of Neurobiology and Behavior
Cornell University, Ithaca, NY

Visiting research assistant — May 2008 – Aug. 2008
Hawai'i Institute of Marine Biology
University of Hawai'i, Honolulu, HI

SCHOLARLY ACTIVITY

PUBLICATIONS

In many mathematical subdisciplines, authorship is traditionally listed in alphabetical order, regardless of overall contribution to the project. References for publications following this approach are italicized below; non-italicized references indicate authorship in order of overall contribution to the project. Bold typeface indicates co-authors

who were undergraduates at the time of submission. References to published articles contain live links – just click.

25. ***M. Beaudouin-Lafon, S. Chen,*** *N. Karst, J. Oehrlein, D. Troxell, "Labeling crossed prisms with a condition at distance two," under review at* Involve *(submitted 9 July 2016).*

24. N. Karst, J. Geddes, R. Carr, "Model microvascular networks can have many equilibria," under review at *Bulletin of Mathematical Biology* (submitted 8 July 2016).

23. D. Dralle, N. Karst, **K. Charalampous**, S. Thompson, "Event-scale power law recession analysis: quantifying methodological uncertainty," under review at *Hydrology and Earth System Sciences* (submitted 8 July 2016).

22. D. Khachatryan, N. Karst, "V for voice: strategies for bolstering communication skills in undergraduate and graduate classrooms," under review at *Journal of Statistics Education* (submitted 6 July 2016).

21. N. Karst, R. Slegers, "Cryptography in context: co-teaching ethics and mathematics," under review at *Problems, Resources, and Issues in Mathematics Undergraduate Studies (PRIMUS)* (submitted 27 May 2016).

20. *N. Karst,* ***J. Langowitz, J. Oehrlein,*** *D. Troxell, "Radio k-Chromatic Number of Cycles for Large k," under review at* Discrete Applied Mathematics *(submitted 23 January 2016).*

19. N. Karst, D. Dralle, S. Thompson, "Spiral and rotor patterns produced by fairy ring fungi," *PLoS ONE*, doi:10.1371/journal.pone.0149254, 2016.

18. D. Dralle, N. Karst, S. Thompson, "Dry season streamflow persistence in seasonal climates," *Water Resources Research*, doi:10.1002/2015WR017752, 2016.

17. D. Dralle, N. Karst, S. Thompson, "a, b careful: The challenge of scale invariance for comparative analyses in power law models of the streamflow recession," *Geophysical Research Letters*, doi:10.1002/2015GL066007, 2015.

16. N. Karst, J. Geddes, and B. Storey, "Oscillations and multiple equilibria in microvascular blood flow," *Bulletin of Mathematical Biology*, doi:10.1007/s11538-015-0089-1, 2015.

15. B. Storey, **D. Hellen**, N. Karst, and J. Geddes, "Observations of spontaneous oscillations in simple two-fluid networks," *Physical Review E*, doi:10.1103/PhysRevE.91.023004, 2015.

14. *N. Karst,* ***J. Oehrlein,*** *D. Troxell, and* ***J. Zhu,*** *"L(d,1)-labeling of the edge-path-replacement by factorization of graphs,"* Journal of Combinatorial Optimization*, doi:10.1007/s10878-013-9632-x, 2015.*

13. *N. Karst,* ***J. Oehrlein****, D. Troxell, and* ***J. Zhu****, "On distance labelings of amalgamations and injective labelings of general graphs,"* Involve*, doi:10.2140/involve.2015.8.535, 2015.*

12. *N. Karst,* ***J. Oehrlein****, D. Troxell, and* ***J. Zhu****, "The minimum span of L(2, 1)-labelings of generalized flowers,"* Discrete Applied Mathematics*, doi:10.1016/j.dam.2014.10.010, 2015.*

11. *N. Karst,* ***J. Oehrlein****, D. Troxell, and* ***J. Zhu****, "Labeling amalgamations of Cartesian products of complete graphs with a condition at distance two."* Discrete Applied Mathematics*, doi:10.1016/j.dam.2014.06.022, 2014.*

10. N. Karst, B. Storey, and J. Geddes, "Spontaneous oscillations in simple fluid networks," *SIAM Journal on Applied Dynamical Systems*, doi:10.1137/130926304, 2014.

9. K. Montovan, N. Karst, T. Seeley, and L. Jones, "Local behavioral rules sustain the cell allocation pattern in the combs of honey bee colonies (Apis mellifera)," *Journal of Theoretical Biology*, doi:10.1016/j.jtbi.2013.07.010, 2013.

8. *S. Adams,* ***N. Howell****, N. Karst, D. Troxell, and* ***J. Zhu****, "On the L(2,1)-labelings of amalgamations of graphs,"* Discrete Applied Mathematics*, doi:10.1016/j.dam.2012.11.007, 2013.*

7. N. Karst and S. Wicker, "On the rekeying load in group key distributions using cover-free families," *IEEE Transactions on Information Theory*, doi:10.1109/TIT.2012.2204542, 2012.

6. *S. Adams, N. Karst,* ***M. Murugan****, and T. Wysocki, "On transceiver signal linearization and the decoding delay of maximum rate complex orthogonal space-time block codes".* IEEE Transactions on Information Theory*, doi:10.1109/TIT.2011.2137050, 2011.*

5. S. Adams, J. Davis, N. Karst, **M. Murugan, B. Lee, M. Crawford**, and **C. Greeley**, "Novel classes of minimal delay and low PAPR rate-1/2 complex orthogonal designs" *IEEE Transactions on Information Theory*, doi:10.1109/TIT.2011.2110730, 2011.

4. *S. Adams, N. Karst, and* ***M. Murugan****, "The final case of the decoding delay problem for maximum rate complex orthogonal designs,"* IEEE Transactions on Information Theory*, doi:10.1109/TIT.2009.2034818, 2010.*

3. S. Adams, J. Seberry, **N. Karst, J. Pollack**, and T. Wysocki, "Quaternion orthogonal designs from complex companion designs," *Linear Algebra and Its Applications*, doi:10.1016/j.laa.2007.09.013, 2008.

2. *S. Adams,* ***N. Karst, and J. Pollack****, "The minimum decoding delay of maximum rate complex orthogonal designs,"* IEEE Transactions on Information Theory*, doi:10.1109/TIT.2007.901174, 2007.*

1. J. Geddes, R. Carr, **N. Karst**, F. Wu, "The onset of oscillations in microvascular blood flow," *SIAM Journal on Applied Dynamical Systems*, doi:10.1137/060670699, 2007.

PRESENTATIONS

Bold typeface indicates an invited talk at a national conference.

13. "An Introduction to R: Linear and Logistic Regression," 2-hour workshop for the Babson College Graduate Student Analytics Club, 12 April 2016.

12. **"Data Analytics for Non-STEM Majors (in the Age of Big Data)" (with D. Khachatryan), Joint Mathematical Meetings, 7 January 2016.**

11. **"Spiral and rotor patterns produced by fairy ring fungi", Fall National Meeting of the American Geophysical Union, 14 December 2015.**

10. "Eliminating a Confounding Factor in Power Law Parameter Interpretation" (poster), Fall National Meeting of the American Geophysical Union, 16 December 2015.

9. "Spectrum allocation and graph labelings: why research is awesome", Olin College, Discrete Mathematics guest lecture, 19 October 2015.

8. "Spectrum allocation and graph labelings: why research is awesome", Olin College, Discrete Mathematics guest lecture, 23 October 2014.

7. "Spontaneous oscillations in simple fluid networks", Babson Faculty Research Chat, 16 October 2014

6. "Ideation exercise", Babson Faculty Learn & Share, 27 August 2014.

5. "From blood flow to lava: the mathematics of oscillating fluids", Wellesley College Mathematics Colloquium Series, 22 April 2014.

4. "Spontaneous oscillations in simple fluid networks", AMS Contributed Paper Session on Applied Mathematics I: Mechanics, Fluids, Waves, Joint Mathematics Meetings, 16 January 2014.

3. "When 'catastrophic' means 'not that bad'", Babson-Olin-Wellesley Applicable Mathematics Series, Olin College, 21 February 2012.

2. "Combinatorial designs for key distribution and secure rekeying in group communication systems", Cornell University, 3 June 2011.

1. "Security, scheduling and statistics: some applications of combinatorial designs", Babson College, 2 March 2011.

BOOK CHAPTERS

2. "I am not a statistic (even if everyone else is): a cross-disciplinary activity", with R. Slegers, in *Evolving Entrepreneurial Education: Innovation in the Babson Classroom*, V. Crittenden, K. Esper, N. Karst, and R. Slegers, eds. Emerald, 2015.

1. "Secure key distribution and revocation for advanced metering infrastructure" with S. Wicker, in *Distributed Sensor Networks*, Second Edition. S. Iyengar and R. Brooks, eds. Chapman & Hall, 2012.

PATENTS

2. "Message rearrangement for improved wireless code performance" (US 8769365 B2), with M. Buckley, S. Simmons, Y. Heo, M. Fong, M. Mahalleh, Z. Cai, A. Earnshaw, 2014.

1. "Message rearrangement for improved code performance" (WO/2012/047235), with M. Buckley, S. Simmons, Y. Heo, M. Fong, M. Mahalleh, Z. Cai, and A. Earnshaw, 2012.

TEACHING

COURSES TAUGHT

- Business Intelligence, Analytics, and Visualization (QTM7571)
- Big Data and Business Analytics (QTM6100)
- Cryptology and Coding Theory (QTM3674)
- Linear Algebra and Dynamical Systems (QTM2600)
- Case Studies in Business Analytics (QTM2000)
- Applied Calculus and Quantitative Methods (QTM1300)
- Quantitative Methods for Business Analytics I (QTM1000)

INDEPENDENT STUDY SUPERVISION

All students were undergraduates at the time of the independent study unless otherwise noted.

(2016) Alison Henry (MBA) , Jonathan Lee (MBA), Jordan Tuch (MBA), Paul vom Eigen (MBA), Haotian Wu (MBA), Zichen Xu (MBA), "Predictive Analytics in R"

(2016) Matthew Beaudouin-Lafon (Olin), Serena Chen (Olin), and Jessica Oehrlein (Olin), "L(2,1) labeling of single cross generalized Peterson graphs" (co-advised with Denise Troxell)

(2015) Jessica Oehrlein (Olin) and Joshua Langowitz (Olin), "Radio k-chromatic number of cycles for large k" (co-advised with Denise Troxell).

(2015) James Gregory, "Gödel, Escher, Bach"

(2015) Simon Shi, "Analysis of a Hubway data set"

(2015) Jessica Oehrlein (Olin) and Joshua Langowitz (Olin), "Radio k-labelings of cycles"" (co-advised with Denise Troxell)

(AY 2014–2015) Roy Murdock, "On the denationalization of money through virtual currency: What can we do to prevent the next financial crisis?" (honors thesis).

(2014) Shivani Janani, "Sagrada Familia: Gaudis Mathematical or Natural Inspiration?" (honors thesis).

(2014) Raagini Rameshwar (Olin), Joshua Langowitz (Olin), Mafalda Borges (Olin), "Computational aspects of L(2,1)-labelings"

(2013) Jessica Oehrlein, Junjie Zhu, "Labeling amalgamations of Cartesian products of complete graphs with a condition at distance two" (co-advised with Denise Troxell)

(2013) Marjorie Kasten (Wellesley), Sophia Guo, Elize Huang (Wellesley), Sarika Patel, and Rachel Insoft (Wellesley), "Optimizing trash collection for BigBelly" as part of the Babson-Olin-Wellesley mathematical consulting in business, industry, and government program

(2013) Paul Booth (Olin), Jessica Oehrlein (Olin), Junjie Zhu (Olin),"L(d,1)-labeling of the edge- path-replacement by factorization of graphs," (co-advised with Denise Troxell)

(2012) Trisha Bakeman, "Linear algebra and dynamical systems"

(2012) Junjie Zhu (Olin), Geoff M. Pleiss (Olin), Paul Booth (Olin), "L(d,1)-labeling of edge-path replacement of graphs," (co-advised with Sarah Adams [Olin] and Denise Troxell)

(2012) Nico von Stackelberg, "Cybersecurity for end users"

(2012) Noura Howell (Olin), and Junjie Zhu (Olin) "On the L(2,1)-labelings of amalgamations of graphs," (co-advised with Sarah Adams and Denise Troxell)

(2012) Paul Booth (Olin), Connor Stokes (Olin), "Spread in graphs,"

(2012) Amy Whitcombe (Olin), Hannah Sarver (Olin), "A scheduling problem related to faculty assignment to honors projects," (co-advised with Sarah Adams and Denise Troxell)

SERVICE

DEPARTMENTAL SERVICE

(2015 – 2016) Faculty search committee for assistant professor of statistics

(2015 – 2016) Faculty search committee for lecturer

(2013 – 2014) MSM program design committee

(2013) QTM1000 curriculum design committee

(2012 – 2013) Faculty search committee for division chair

(2012 – 2013) Faculty search committee for assistant professor of statistics

(2012 – 2013) Curriculum refresh committee

COLLEGIATE SERVICE

(2015 – 2016) Provost search committee

(2014) Co-editor of *Evolving Entrepreneurial Education: Innovation in the Babson Classroom*

(2014 –) Center for Engaged Learning and Teaching faculty collaborative committee

(2014) Co-organizer of the annual Faculty Learn & Share (focused on pedagogical research)

(2013 –) Honors council member

(2012 – 2014) Faculty senate alternate

(2012 –) Honor board member

(2012 – 2014) Babson-Olin-Wellesley committee

(2011 – 2013) First Year Seminar adviser

PROFESSIONAL SERVICE

(2014) Co-chaired AMS Contributed Paper Session: Mechanics, Fluids, and Waves at 2014 Joint Mathematics Meetings

(2013) Co-organized flipped classroom panel for Project NExT participants at 2013 Mathfest

AWARDS AND HONORS

(2016) Babson Faculty Research Fund course release for "Variability in streamflow recession"

(2015) Dean's Award for Excellence in Scholarship (four awarded annually college-wide)

(2015) Babson Faculty Research Fund course release for "Spiral wave formation in fairy ring fungi"

(2014) Dean's Award for Excellence in Undergraduate Teaching (four awarded annually college-wide)

(2014) Babson Faculty Research Fund grant for "Oscillations and spontaneous flow reversal in a simple fluid network"

(2013) Babson Teaching Innovation Fund grant "Cryptology in context"

(2012 – 2013) Project NExT (New Experiences in Teaching) Fellow, Mathematical Association of America.

(2007 – 2009) Integrative Graduate Education and Research Traineeship (IGERT), National Science Foundation.

(2003 – 2007) Franklin W. Olin full tuition scholarship, Franklin W. Olin Foundation.