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Contents

I Earned Degrees **2**

II Employment History **2**

III Honors and Awards **2**

IV Reseasrch, Scholarship, and Creative Activities **2**

B Referred Publications and Submitted Articles . . . 2
B.1 Published and Accepted Journal Articles . . . 2
B.2 Conference Presentation with Proceedings (Refereed) . . . 3
D Presentations . . . 6
D.1 Invited Speaker at Workshops . . . 6
D.2 Invited Talks at Seminars . . . 7
E Grants and Contracts . . . 7
E.1 As Principle Investigator . . . 7
F Other Scholarly and Creative Accomplishments . . . 8

V Education **8**

A Courses Taught . . . 8
B Individual Student Guidance . . . 8
B.1 Ph.D. Students . . . 8
B.2 M.S. Students . . . 8
B.3 Postdocs . . . 8
B.4 Undergraduate Students . . . 9
B.5 Service on thesis or dissertation committees . . . 9
C Education Innovations and Other Contributions . . . 9

VI Service **9**

A Professional Contributions . . . 9
A.1 Conference Program Committees . . . 9
A.2 Conference Reviewer . . . 9
A.3 Journal Reviewer . . . 9
C Institute Contributions . . . 10

I Earned Degrees

- *Postdoctoral Instructor in Applied Mathematics*,
  Department of Mathematics, Massachusetts Institute of Technology, 2013 - 2015,
  Supervisor: Professor Jonathan A. Kelner.

- *Ph.D. in Computer Science*,
  Carnegie Mellon University, 2009 - 2013,
  Advisor: Professor Gary L. Miller,
  Thesis: Algorithm Design using Spectral Graph Theory.

- *B. Math*,
  University of Waterloo, 2006 - 2009,
  Double major in Computer Science and Combinatorics & Optimization.

II Employment History

- *Assistant Professor*, Georgia Institute of Technology, Fall 2015 - present.

- *Research Intern*, Microsoft Research New England, Summer 2011.

- *Software Engineering Intern*, Google Seattle, Summer 2009.

- *Undergraduate Research Assistant*, University of Waterloo, Summer 2008.

III Honors and Awards

- *CMU SCS Dissertation Award*, 2013.

- *Microsoft Research PhD Fellowship*, 2011.

IV Reseasrch, Scholarship, and Creative Activities

B Referred Publications and Submitted Articles

B.1 Published and Accepted Journal Articles

- Partitioning Well-Clustered Graphs: Spectral Clustering Works!
  with He Sun and Luca Zanetti.
  Accepted to SIAM Journal on Computing (SICOMP).
  Preliminary version in COLT 2015.
  Available at http://arxiv.org/abs/1411.2021.

- Faster Spectral Sparsification and Numerical Algorithms for SDD Matrices.
  with Alex Levin and Ioannis Koutis.
  In ACM Transactions on Algorithms (TALG) 12.2 (2016): 17.
  Preliminary version appeared in STACS 2012.
  Available at: http://arxiv.org/abs/1209.5821.

- Approaching Optimality for Solving SDD Linear Systems
  with Ioannis Koutis and Gary L. Miller.
  In SIAM Journal on Computing (SICOMP), Vol. 43 No. 1, pp 337-354, 2014.

Preliminary version appeared in FOCS 2010.
Available at http://arxiv.org/abs/1003.2958.

- Near linear Linear-Work Parallel SDD Solvers, Low-Diameter Decomposition, and Low-Stretch Subgraphs
with Guy E. Blelloch, Anupam Gupta, Ioannis Koutis, Gary L. Miller, and Kanat Tangwongsan.
In Theory of Computing Systems, Vol. 55, No. 3, pp. 521-554, 2014.
Preliminary version appeared in SPAA 2011.
Available at http://arxiv.org/abs/1111.1750.

- A Fast Solver for a Class of Linear Systems.
with Ioannis Koutis and Gary L. Miller.
In Communications of the ACM, Vol. 55 No. 10, pp. 99-107, 2012.

- Efficient Triangle Counting in Large Graphs via Degree-based Vertex Partitioning.
with Mihail Kolountzakis, Gary Miller, and Charalampos Tsourakakis.
In Internet Mathematics, Volume 8, No. 1-2, pp. 161–185, 2012.
Preliminary version appeared in WAW 2010.
Available at http://arxiv.org/abs/1011.0468.

- Approximate Dynamic Programming for Fast Denoising of aCGH Data.
with Gary L. Miller, Russell Schwartz, and Charalampos E. Tsourakakis.
In ACM Journal of Experimental Algorithmics, Volume 16, Article No. 1.8, 2011.
Preliminary version appeared in SODA 2011.
Available at http://arxiv.org/abs/1003.4942.

B.2 Conference Presentation with Proceedings (Refereed)

- Solving Directed Laplacians in Nearly Linear Time through Sparse LU Factorizations.
with Michael B. Cohen, Jonathan Kelner, Rasmus Kyng, John Peebles, Anup B. Rao, and Aaron Sidford.
In FOCS 2018.

- Graph Sparsification, Spectral Sketches, and Faster Resistance Computation, via Short Cycle Decompositions.
with Timothy Chu, Yu Gao, Richard Peng, Sushant Sachdeva, Saurabh Sawlani, and Junxing Wang.
In FOCS 2018.
Available at: https://arxiv.org/abs/1805.12051

- Graph Sketching Against Adaptive Adversaries Applied to the Minimum Degree Algorithm.
with Matthew Fahrbach, Gary L. Miller, Saurabh Sawlani, Junxing Wang, and Shen Chen Xu. In FOCS 2018.
Available at: https://arxiv.org/abs/1804.04239.

- Incomplete Nested Dissection.
with Rasmus J. Kyng, Robert Schwieterman, and Peng Zhang.
In STOC 2018.
Available at: https://arxiv.org/abs/1805.09442

- Parameterizing the Hardness of Binary Search Tree Access Sequences by Inversion Counts.
with Meng He and Yinzhan Xu.
In ANALCO 2018.

- Determinant-Preserving Sparsification of SDDM Matrices with Applications to Counting and Sampling Spanning Trees.
  with David Durfee, John Peebles, and Anup B. Rao.
  In FOCS 2017.
  Available at: https://arxiv.org/abs/1705.00985.

- Density Independent Algorithms for Sparsifying k-Step Random Walks. with Gorav Jindal, Pavel Kolev, and Saurabh Sawlani.
  In APPROX 2017.
  Available at: https://arxiv.org/abs/1702.06110.

- Almost-Linear-Time Algorithms for Markov Chains and New Spectral Primitives for Directed Graphs.
  with Michael B. Cohen, Jonathan A. Kelner, John Peebles, Anup B. Rao. Aaron Sidford, and Adrian Vladu.
  In STOC 2017.
  Available at: https://arxiv.org/abs/1611.00755.

- A Framework for Analyzing Resparsification Algorithms.
  with Rasmus J. Kyng, Jakub Pachocki, and Sushant Sachdeva.
  In SODA 2017.
  Available at: https://arxiv.org/abs/1611.06940.

- SPALS: Fast Alternating Least Squares via Implicit Leverage Scores Sampling.
  with Dehua Cheng, Ioakeim Perros, and Yan Liu.
  In NIPS 2016.

- An Empirical Study of Cycle Toggling Based Laplacian Solvers.
  with Kevin Deweese, John R. Gilbert, Gary L. Miller, Hao Ran Xu, and Shen Chen Xu.
  In CSC 2016.
  Available at: https://arxiv.org/abs/1609.02957.

- Faster Algorithms for Computing the Stationary Distribution, Simulating Random Walks, and More.
  with Michael B. Cohen, Jon Kelner, John Peebles, Aaron Sidford, and Adrian Vladu.
  In FOCS 2016.
  Available at http://arxiv.org/abs/1608.03270.

- On Fully Dynamic Graph Sparsifiers
  with Ittai Abraham, David Durfee, Ioannis Koutis, and Sebastian Krinninger.
  In FOCS 2016.
  Avaiable at: http://arxiv.org/abs/1604.02094.

- Simple and Scalable Constrained Clustering: A Generalized Spectral Method.
  with Mihai Cucuringu, Ioannis Koutis, Sanjay Chawla, and Gary Miller.
  In AISTATS 2016.
  Available at http://www.math.ucla.edu/~mihai/consClust_AISTATS.pdf.

- Sparsified Cholesky and Multigrid Solvers for Connection Laplacians.
  with Rasmus Kyng, Yin Tat Lee, Sushant Sachdeva, and Daniel A. Spielman.
  In STOC 2016.
  Available at: http://arxiv.org/abs/1512.01892.

- Faster and Simpler Width-Independent Parallel Algorithms for Positive Semidefinite Programming.
  with Kanat Tangwongsan and Peng Zhang.

Updated 2016, Preliminary version in SPAA 2012.
Available at http://arxiv.org/abs/1201.5135.

- Approximate Undirected Maximum Flows in $O(mpolylog(n))$ Time
  In SODA 2016.
  Available at http://arxiv.org/abs/1411.7631.

- Scalable Large Near-Clique Detection in Large-Scale Networks via Sampling
  with Charalampos E. Tsourakakis, Michael Mitzenmacher, Jakub W. Pachocki, and Shen Chen Xu.
  In KDD 2015.
  Available at http://www.cc.gatech.edu/~rpeng/MitzenmacherPPTX15.pdf.

- Efficient Sampling for Gaussian Graphical Models via Spectral Sparsification.
  with Dehua Cheng, Yu Cheng, Yan Liu, and Shang-Hua Teng.
  In COLT 2015. Available at http://arxiv.org/abs/1410.5392.

- ℓ_p Row Sampling by Lewis Weights. with Michael B. Cohen.
  In STOC 2015.
  Available at http://arxiv.org/abs/1412.0588.

- Improved Parallel Algorithms for Spanners and Hopsets.
  with Gary L. Miller and Shen Chen Xu.
  In SPAA 2015.
  Available at http://arxiv.org/abs/1309.3545.

- Uniform Sampling for Matrix Approximation.
  with Michael B. Cohen, Yin Tat Lee, Cameron Musco, Christopher Musco, and Aaron Sidford.
  In ITCS 2015.
  Available at http://arxiv.org/abs/1408.5099.

- Solving SDD Linear Systems in Nearly $mlog^{1/2}n$ Time. with Michael B. Cohen, Rasmus Kyng, Gary L. Miller, Jakub W. Pachocki, Anup B. Rao and Shen Chen Xu.
  In STOC 2014.
  This paper is a merger of the following two manuscripts on arXiv:

  - Preconditioning in Expectation. with Michael B. Cohen, Rasmus Kyng, Jakub W. Pachocki, and Anup Rao.
    Available at http://arxiv.org/abs/1401.6236
  - Stretching Stretch. with Michael B. Cohen, Gary L. Miller, Jakub W. Pachocki, and Shen Chen Xu. Available at http://arxiv.org/abs/1401.2454.

- An Efficient Parallel Solver for SDD Linear Systems. with Daniel A. Spielman.
  In STOC 2014.
  Available at http://arxiv.org/abs/1311.3286.

- Solving 1-Laplacians of Convex Simplicial Complexes in Nearly Linear Time: Collapsing and Expanding a Topological Ball. with Michael B. Cohen, Brittany Terese Fasy, Gary L. Miller, Amir Nayyeri, and Noel Walkington.
  In SODA 2014.
  Available at http://www.cc.gatech.edu/~rpeng/CohenFMNPW14.pdf.

- Fully Dynamic $(1+\epsilon)$-Approximate Matchings
  with Manoj Gupta.
  In FOCS 2013.
  Available at http://arxiv.org/abs/1304.0378.

- Iterative Row Sampling.
  with Mu Li and Gary L. Miller.
  In FOCS 2013.
  Available at http://arxiv.org/abs/1211.2713.

- Parallel Graph Decompositions Using Random Shifts.
  with Gary L. Miller and Shen Chen Xu.
  In SPAA 2013.
  Available at http://arxiv.org/abs/1307.3692.

- Runtime Guarantees for Regression Problems.
  with Hui Han Chin, Aleksander Madry, and Gary L. Miller.
  In ITCS 2013.
  Available at http://arxiv.org/abs/1110.1358.

- Approximate Maximum Flow on Separable Undirected Graphs. with Gary L. Miller.
  In SODA 2013.
  Available at http://arxiv.org/abs/1210.5227.

- Faster Approximate Multicommodity Flow Using Quadratically Coupled Flows.
  with Jonathan A. Kelner and Gary L. Miller.
  In STOC 2012.
  Available at http://arxiv.org/abs/1202.3367.

- A Nearly mlogn Time Solver for SDD Linear Systems.
  with Ioannis Koutis and Gary L. Miller.
  In FOCS 2011.
  Available at http://arxiv.org/abs/1102.4842.

- Linear-Work Greedy Parallel Approximate Set Cover and Variants. with Guy E. Blelloch and Kanat Tangwongsan.
  In SPAA 2011.
  Available at http://www.cc.gatech.edu/ ~rpeng/BlellochPT11.pdf.

D Presentations

D.1 Invited Speaker at Workshops

- June 2017, "Determinant Preserving Sparsification of SDDM Matrices with Applications to Counting and Sampling Spanning Trees", Theory @ Nanjing 2017.

- Mar 2017, "High Performance Solvers for Linear Systems in Graph Laplacians", NSF Algorithms in the Field PI meeting.

- Feb 2017, "High Performance Solvers for Linear Systems in Graph Laplacians", SIAM Conference on Computer Science and Engineering (CSE) 2017.

- Sep 2016, "Parallel Graph Algorithms", 5^{th} Workshop on Advances in Distributed Graph Algorithms.

- Aug 2016, "Algorithm Frameworks Based on Adaptive Sampling", Banff International Research Station Workshop on Algebraic and Spectral Graph Theory.
- July 2016, "ℓ_p Row Sampling by Lewis Weights", NII Shonan Meeting on Recent Advances in Randomized Numerical Linear Algebra.
- July 2016, "Algorithm Frameworks Based on Adaptive Sampling", IAS/Park City Mathematics Institute Summer Session 2016.
- Jan 2016, "Algorithm Frameowrks Based on Structure Preserving Sampling", UC San Diego Workshop on Big Graphs.
- July 2015, "Approximate Undirected Maximum Flows in $O(m\text{polylog}(n))$ Time", 22^{nd} International Symposium on Mathematical Programming 2015.

D.2 Invited Talks at Seminars

- August 2018, "Faster Computations of Effective Resistances", Machine Learning and Optimization Seminar at MSR Redmond.
- May 2018, "Fully Dynamic Effective Resitances", Theory Lunch at MSR Redmond.
- June 2017, "Determinant Preserving Sparsification of SDDM Matrices with Applications to Counting and Sampling Spanning Trees", ITCS seminar at SHUFE.
- Nov 2016, "Almost-Linear-Time Algorithms for Markov Chains and New Spectral Primitives for Directed Graphs", Duke University Algorithms Seminar.
- Oct 2016, "Directed Spectral Sparsification and Laplacian Solvers in Almost Linear Time", UT Austin CS Theory Seminar.
- June 2016, "Sparsified Matrix Algorithms for Graph Laplacians", ITCS seminar at SHUFE.
- Mar 2016, "Sparsified Matrix Algorithms for Graph Laplacians", UC Irvine Applied & Computational Mathematics Seminar .
- Oct 2015, "Algorithm Frameowrks Based on Structure Preserving Sampling", UC Berkeley AMPLab Seminar.

E Grants and Contracts

E.1 As Principle Investigator

- Title of Project: AitF: Collaborative Research: High Performance Linear System Solvers with Focus on Graph Laplacians
  Agency: NSF
  Total Dollar Amount: 800,000
  Role: PI
  Collaborators: John Gilbert (co-PI, UCSB), Gary Miller (co-PI, CMU)
  Period of Contract: 9/1/2016 - 8/31/2020
  Candidates Share: 33% (266,666)

- Title of Project: AF: Small: New Algorithmic Primitives for Directed Graphs: Sparsification and Preconditioning
  Agency: NSF
  Total Dollar Amount: 450,000
  Role: PI
  Collaborators: none
  Period of Contract: 7/1/2017 - 6/30/2020
  Candidates Share: 100% (450,000)

F Other Scholarly and Creative Accomplishments

- Co-organizer of Dagstuhl Seminar 18241 'High-Performance Graph Algorithms' in June 2018. Website at https://www.dagstuhl.de/en/program/calendar/semhp/?semnr=18241.
- Organized session 'High Performance Spectral Algorithms' at the 2017 SIAM Annual Meeting. Program at http://meetings.siam.org/sess/dsp_programsess.cfm?SESSIONCODE=62686.

V Education

A Courses Taught

- Fall 2018, CS 4510 Automata and Complexity, Georgia Tech, $\approx$ 180 students.
- Fall 2017, CS 3510 Design and Analysis of Algorithms, Georgia Tech, 312 students.
- Spring 2017, CS 7540, Spectral Algorithms, Georgia Tech, 21 students.
- Fall 2016, CS 3510 Design and Analysis of Algorithms, Georgia Tech, 82 students.
- Fall 2015, CS 8803-SA Sampling Algorithms, Georgia Tech, 21 students.

B Individual Student Guidance

B.1 Ph.D. Students

- Yu Gao, Fall 2017 - present.
- Saurabh Sawlani, Fall 2016 - present, `https://www.cc.gatech.edu/~ssawlani3/`.
- David Durfee, Fall 2015 - present, `https://www.cc.gatech.edu/~ddurfee3/`.
- Peng Zhang, Fall 2015 - Summer 2018, `https://sites.google.com/site/pengzhang27182/`, postdoc at Yale University 2018 - present.

B.2 M.S. Students

- Qian Lyu, Fall 2017.
- Robert Schwieterman, Fall 2017 - Spring 2018.

B.3 Postdocs

- Di Wang, Winter 2018 - present.

B.4 Undergraduate Students

- Marta Andres Arroyo, May - September 2016.

B.5 Service on thesis or dissertation committees

- David Durfee
- Tung Mai
- Saurabh Sawlani
- Chi Ho Yuen
- Yan Wang
- Peng Zhang

C Education Innovations and Other Contributions

With programming competitions, which are algorithmic problem solving based outreach programs.

- Coach for USA Computing Olympiad (USACO), 2006 - 2017.
- Problem setter for International Olympiad in Informatics (IOI), Host Scientific Committee: 2008, 2009, 2010; external task submitter: 2011, 2013; IOI Scientific Committee (elected): 2014 - 2018.
- Helping with collegiate programming teams: Georgia Tech 2015 - present, M.I.T. 2013 - 2015, Carnegie Mellon University 2010 - 2013, University of Waterloo 2008 - 2009.

VI Service

A Professional Contributions

A.1 Conference Program Committees

NCTCS 2018, ESA 2018, SODA 2018, RANDOM 2017, WADS 2017, SPAA 2017, APPROX 2016, FOCS 2015.

A.2 Conference Reviewer

CCC 2017, 2012; COLT 2018, 2016; ESA 2018, 2016, 2015, 2013; FOCS 2018, 2017, 2016, 2015, 2014, 2013; ICALP 2018, 2017, 2016; NIPS 2018, 2016; PODC 2017, 2016; SOCG 2018, 2015; SODA 2017, 2016, 2015, 2013; SPAA 2014; STOC 2018, 2017, 2016, 2015, 2014; WADS 2017.

A.3 Journal Reviewer

ALGO, JACM, RSA, SICOMP, SIDMA, SIMAX, SIOPT, SISC, TCS, TKDD, TOC.

C Institute Contributions

- PhD Review Committee, 2017.
- Theory area coordinator, 2015 - 2017.
- PhD admissions coordinator, 2016 - 2017.
- Faculty Recruiting Committee, 2016 - 2017.