Tianran Chen

Curriculum Vitae

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Experience

2017 – **Assistant Professor**, *Auburn University Montgomery*.

2016 – 2017 **Lecturer**, *Auburn University Montgomery*.

2012 – 2016 **Research Instructor**, *Michigan State University*.

2006 – 2012 **Research and Teaching Assistant**, *Michigan State University*.

Education

2012 **Ph.D. Applied Mathematics**, *Michigan State University*, (MI USA).
- Dissertation: *Projective path tracking for homotopy continuation method*
- Advisor: Tien-Yien Li

2005 **B.A. Computer Science**, *Western Connecticut State University*, (CT USA).
Secondary major in Mathematics

Grants & Awards

2019 NSF grant DMS-1923099 *AMPS: Collaborative Research: A convex geometry and homotopy approach for power-flow equations*. Role: PI (in collaboration with separately funded co-PI Robert Davis at Colgate University)

2016 AMS-Simons Travel Grant

2014 A paper selected for Journal of Chemical Physics Editors' Choice for 2014

2010 Dr. Paul & Wilma Dressel endowed scholarship award
(*Michigan State University*)

2005 Student leadership recognition award for outstanding leadership
(*Western Connecticut State University*)

2005 Sigma Xi research award in Physics, Astronomy & Meteorology
(*Western Connecticut State University*)

2004 Wohlever award in Computer Science
(*Western Connecticut State University*)

Research Interests

Numerical analysis, scientific computing, high performance computing, numerical algebraic geometry, computational geometry, applications of numerical methods in physics, chemistry, and engineering.

Publications

(18) 2019 Directed acyclic decomposition of Kuramoto equations
Chaos: An Interdisciplinary Journal of Nonlinear Science (accepted)
https://arxiv.org/abs/1903.04492

(17) 2019 Unmixing the mixed volume computation
Discrete & Computational Geometry
https://doi.org/10.1007/s00454-019-00078-x

(16) 2018 Counting equilibria of the Kuramoto model using birationally invariant intersection index
SIAM Journal on Applied Algebra and Geometry 2018 2:4, 489-507
(With Robert Davis and Dhagash Mehta)
https://doi.org/10.1137/17M1145665

(15) 2018 libtropicon: A Scalable Library for Computing Intersection Points of Generic Tropical Hyper-surfaces. *In: Davenport J., Kauers M., Labahn G., Urban J. (eds) Mathematical Software – ICMS 2018. ICMS 2018. Lecture Notes in Computer Science, vol 10931. Springer, Cham*
https://doi.org/10.1007/978-3-319-96418-8_13

(14) 2017 A Product Formula for the Normalized Volume of Free Sums of Lattice Polytopes. *Advances in Algebra: Research from the Southern Regional Algebra Conference 2017*
(With Robert Davis) https://arxiv.org/abs/1711.11130

(13) 2017 Fixed points of belief propagation: An analysis via polynomial homotopy continuation. *IEEE Transactions on Pattern Analysis and Machine Intelligence* Volume 40, Issue 9, 0162-8828, Sep. 2018, pp. 2124-2136
(with Christian Knoll, Dhagash Mehta, and Franz Pernkopf).
https://doi.org/10.1109/TPAMI.2017.2749575

(12) 2017 On the Network Topology Dependent Solution Count of the Algebraic Load Flow Equations. *IEEE Transactions on Power Systems* (2017)
(with Dhagash Mehta). https://doi.org/10.1109/TPWRS.2017.2724030

(11) 2017 Mixed cell computation in Hom4PS-3.
Journal of Symbolic Computation Volume 79, Part 3, Mar.–Apr. 2017, pp. 516-534.
(with Tsung-Lin Lee and Tien-Yien Li).
http://dx.doi.org/10.1016/j.jsc.2016.07.017

(10) 2017 Parallel degree computation for binomial systems.
Journal of Symbolic Computation Volume 79, Part 3, Mar.–Apr. 2017, pp. 535-558.
(with Dhagash Mehta). http://dx.doi.org/10.1016/j.jsc.2016.07.018

(9) 2015 Response to "Comment on 'Exploring the potential energy landscape of the Thomson problem via Newton homotopies"'.
The Journal of Chemical Physics 143, 247102, 2015.
(with Dhagash Mehta, John Morgan, and David Wales).
http://dx.doi.org/10.1063/1.4939011

(8) 2015 Homotopy continuation method for solving systems of nonlinear and polynomial equations.
Communications in Information and Systems 15(2):119–307, 2015.
(with Tien-Yien Li). http://dx.doi.org/10.4310/CIS.2015.v15.n2.a1

(7) 2015 Exploring the potential energy landscape of the Thomson problem via Newton homotopies. *The Journal of Chemical Physics* 142, 194113, 2015.
(with Dhagash Mehta, John Morgan, and David Wales).
http://dx.doi.org/10.1063/1.4921163

(6) 2014 Theoretical aspects of mixed volume computation via mixed subdivision.
Communications in Information and Systems 14(4):213–242, 2014.
(with Tien-Yien Li and Xiaoshen Wang).
http://dx.doi.org/10.4310/CIS.2014.v14.n4.a1

(5) 2014 Newton homotopies for sampling stationary points of potential energy landscapes. *The Journal of Chemical Physics* 141 (12), 121104, 2014.
(with Dhagash Mehta, Jonathan Hauenstein, and David Wales).
http://dx.doi.org/10.1063/1.4896657
http://scitation.aip.org/content/jcp-editors-choice-for-2014 (**Selected for a Journal of Chemical Physics Editors' Choice for 2014**)

(4) 2014 Solutions to systems of binomial equations.
Annales Mathematicae Silesianae 28:7–34, 2014.
(with Tien-Yien Li)

(3) 2014 Hom4PS-3: A parallel numerical solver for systems of polynomial equations based on polyhedral homotopy continuation methods *Mathematical Software – ICMS 2014 – 4th International Congress, Seoul, South Korea, August 5-9, 2014. Proceedings* 8592:183–190, 2014.
(with Tsung-Lin Lee and Tien-Yien Li).
http://dx.doi.org/10.1007/978-3-662-44199-2_30

(2) 2014 Mixed cells computation in parallel.
Taiwanese Journal of Mathematics 18(1):93–114, 2014.
(with Tsung-Lin Lee and Tien-Yien Li).
http://dx.doi.org/10.11650/tjm.18.2014.3276

(1) 2012 Spherical projective path tracking for homotopy continuation methods.
Communications in Information and Systems 12(3):195–220, 2012.
(with Tianran Chen and Tien-Yien Li).
http://dx.doi.org/10.4310/CIS.2012.v12.n3.a2)

Preprints

2018 On the equality of BKK bound and birationally invariant intersection index.
(http://arxiv.org/abs/1812.05408)

2018 (With Robert Davis) A toric deformation method for solving Kuramoto equations.
(http://arxiv.org/abs/1810.05690)

2018 (With Dhagash Mehta, Tingting Tang and Jonathan D. Hauenstein) The loss surface of deep linear networks viewed through the algebraic geometry lens. (http://arxiv.org/abs/1810.07716)

2016 (With Dhagash Mehta and Matthew Niemerg) A network topology dependent upper bound on the number of equilibria of the Kuramoto model.
(http://arxiv.org/abs/1512.04987)

2015 (With Dhagash Mehta) An index-resolved fixed-point homotopy and potential energy landscapes. (http://arxiv.org/abs/1504.06622)

Scientific Software

- Core developer of Hom4PS-3 (http://www.hom4ps3.org): A parallel numerical solver for systems of polynomial equations based on the Polyhedral Homotopy Method.
- Lead developer of MixedVol-3 (http://www.hom4ps3.org): A parallel software package for computing volume of polytopes, mixed volume, BKK bound, and fine mixed cells.
- Developer of libtropicana (https://github.com/chentianran/libtropicana): A software package for computing regular triangulations for lattice polytopes.
- Developer of kap-cycle (https://github.com/chentianran/kap-cycle): A Python package for generating geometric information related to the Adjacency Polytope associated with Kuramoto cycle networks.

Invited Presentations and Lectures

Apr. 2019 Meeting on Applied Algebraic Geometry
Georgia Institute of Technology, Atlanta, GA USA

Nov. 2018 American Mathematical Society Fall Southeastern Sectional Meeting.
University of Arkansas, Fayetteville, AR USA

Sep. 2018 ICERM 2018 Semester program on nonlinear algebra.
Brown University. Providence, RI USA

Jul. 2018 International Congress on Mathematical Software. South Bend, IL USA

Jul. 2018 SIAM Annual Meeting. Portland, OR USA

Apr. 2018 Southern Regional Algebra Conference. Montgomery, AL USA

Oct. 2017 Auburn Unversity. Auburn, AL USA

Aug. 2017 2017 SIAM Conference on Applied Algebraic Geometry. Atlanda, GA USA

Mar. 2017 Georgia Institute of Technology. Atlanta, GA USA

Mar. 2017 Southern Regional Algebra Conference. Mobile, AL USA

Oct. 2016 Workshop on Numerical Algebraic Geometry (CSU). Fort Collins, CO USA.

Oct. 2016 American Mathematical Society Fall Western Sectional Meeting. Denver, CO USA.

Jul. 2016 SIAM Annual Meeting. Boston, MA USA.

Mar. 2015 American Mathematical Society Central Sectional Meeting Spring.
Michigan State University. East Lansing, MI USA.

Aug. 2014 The 4th International Congress on Mathematical Software. Seoul, South Korea.

Jan. 2014 American Mathematical Society Joint Mathematics Meetings. Baltimore, MD USA.

Aug. 2013 SIAM Conference on Applied Algebraic Geometry.
Colorado State University. Fort Collins, CO USA.

Jun. 2013 Chengdu Institute of Computer Applications. Sichuan, China.

Oct. 2011 SIAM Conference on Applied Algebraic Geometry.
North Carolina State University. Raleigh, NC USA.

May 2011 Midwest Numerical Analysis Day. West Lafayette, IN USA.

Apr. 2011 Numerical algebraic geometry seminar.
Colorado State University. Fort Collins, CO USA.

Nov. 2010 1064th American Mathematical Society Meeting.
University of Notre Dame. Notre Dame, IN USA.

Student Projects Supervised

2018 Algebraic Kuramoto equations (with Evgeniia Korchevskaia)

2013 Reliable communication in large scale parallel computing (with Nick Ovenhouse)

2012 A web interface for a scientific database based on Flask (with Jared Jonckheere)

2012 A JIT compiler for automatic differentiation based on LLVM (with Nick Ovenhouse)

Teaching Experience

2016 – **Instructor**, *Introduction to Programming for Engineers and Scientists, College algebra, Precalculus, Calculus I,II, Multivariable Calculus, Linear Algebra, Mathematical Modeling and Simulations, Modern Algebra I, Modern Algebra II, Differential equations, Numerical analysis*.

2012 – 2016 **Instructor**, *College level algebra courses, Calculus sequence, Calculus sequence for business majors, Linear Algebra, Transition to Advanced Mathematics, Abstract algebra*.

2006 – 2011 **Teaching assistant**, *College Algebra, Finite Mathematics and Elements of College Algebra, Survey of Calculus with Applications I & II, Calculus I*.

Professional Services

2019 Co-organizer for the *Special Session on Applications of Algebraic Geometry* at the American Mathematical Society 2019 Southeastern Sectional Meeting

2018 Organizer for the Southern Regional Algebra Conference 2018

2017 Organizer for the *Special Session on Algorithms and Implementation in Numerical Algebraic Geometry*, 2017 SIAM Conference on Applied Algebraic Geometry

2015 Co-organizer for the *Special Session on Homotopy Continuation Methods and Their Applications to Science and Engineering* at the American Mathematical Society 2015 Central Spring Sectional Meeting

Reviewer for

- ACM Transactions on Mathematical Software
- International Symposium on Symbolic and Algebraic Computation
- Journal of Discrete & Computational Geometry
- LMS Journal of Computation and Mathematics
- IEEE Transactions on Power Systems
- IEEE Power Engineering Letters
- SIAM Journal on Applied Dynamical Systems