

# Tianran Chen

## Curriculum Vitae

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### Experience

- 2016 – **Assistant Professor**, *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

- 2019 NSF Award No.1923099 *AMPS: Collaborative Research: A convex geometry and homotopy approach for power-flow equations*. (\$105,281) Role: PI (in collaboration with separately funded co-PI Robert Davis at Colgate University)  
2016 AMS-Simons (American Mathematical Society & Simons Foundation) Travel Grant

### Awards

- 2020 Outstanding Faculty Award  
(*Department of Mathematics, Auburn University Montgomery*)  
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/higher performance computing
- Numerical algebraic geometry
- Application of numerical methods in physics, chemistry, engineering

## Publications

- (19) 2019 Three Formulations of the Kuramoto Model as a System of Polynomial Equations  
*2019 57th Annual Allerton Conference on Communication, Control, and Computing (Allerton)*  
(with J. MAREČEK, D. MEHTA and M. NIEMERG) 2019, pp. 810-815  
<https://doi.org/10.1109/ALLERTON.2019.8919934>.
- (18) 2019 Directed acyclic decomposition of Kuramoto equations  
*Chaos: An Interdisciplinary Journal of Nonlinear Science*. 2019 Vol.29, Issue 9  
<https://doi.org/10.1063/1.5097826>
- (17) 2019 Unmixing the mixed volume computation  
*Discrete & Computational Geometry*. 2019, 62:55–86  
<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](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>  
**(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 & TIEN-YIEN LI).  
[http://dx.doi.org/10.1007/978-3-662-44199-2\\_30](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 & 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 TIEN-YIEN LI).  
<http://dx.doi.org/10.4310/CIS.2012.v12.n3.a2>

## Preprints

- 2019 (With EVGENIIA KORCHEVSKAIA) On the root count of algebraic Kuramoto equations in cycle networks with uniform coupling. (<http://arxiv.org/abs/1912.06241>)
- 2019 (With Evgeniia Korchevskaia) Graph edge contraction and adjacency polytopes. (<https://arxiv.org/abs/1912.02841>)
- 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>)
- 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 libtropicalana (<https://github.com/chentianran/libtropicalana>): 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 University. Auburn, AL USA
- Aug. 2017 2017 SIAM Conference on Applied Algebraic Geometry. Atlanta, 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.

## Undergraduate student Projects Supervised

- 2019 Adjacency polytopes (with Evgeniia Korchevskaia) Resulted in preprints:  
Graph edge contraction and adjacency polytopes. (<https://arxiv.org/abs/1912.02841>)
- 2019 3D printing in mathematical education (with Jamison Hood)
- 2019 Power-flow equations (with Matthew Little)
- 2018 Algebraic Kuramoto equations (with Evgeniia Korchevskaia) Resulted in preprints:  
On the root count of algebraic Kuramoto equations in cycle networks with uniform coupling.  
(<http://arxiv.org/abs/1912.06241>)
- 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, Pre-calculus, 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