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Silviana Amethyst, PhD

Professional Experience

2022 - **Associate Professor**
Department of Mathematics, University of Wisconsin – Eau Claire

2017 - 2022 **Assistant Professor**
Department of Mathematics, University of Wisconsin – Eau Claire

Fall 2019 **Visiting Scholar**
Institute for Computational and Experimental Research in Mathematics (ICERM), Brown University, Semester Program: Visualizing Mathematics

Fall 2018 **Visiting Scholar**
Institute for Computational and Experimental Research in Mathematics (ICERM), Brown University, Semester Program: Nonlinear Algebra

2014 - 2017 **Postdoctoral Research Associate**
Department of Applied and Computational Mathematics and Statistics, University of Notre Dame, Notre Dame
Department of Mathematics, North Carolina State University, Raleigh
Applications of numerical algebraic geometry
Mentor – Jonathan Hauenstein

2013 **Postdoctoral Researcher**
Department of Mathematics, Colorado State University, Fort Collins
Real numerical algebraic geometry.
Mentor – Dan Bates

Leading up to PhD

Fall 2009 **Research Assistant**
Huygens Laboratorium, Universiteit Leiden, Holland
Mentor – Martin Van Hecke

2007 - 2012 **Graduate Research Assistant, Graduate Teaching Assistant**
Department of Mathematics, Colorado State University, Fort Collins
Advisors – Vakhtang Putkaradze, Tony Maciejewski

Education

2012 **Doctor of Philosophy, Mathematics**
Colorado State University, Fort Collins,
Applied Mathematics
Advisors – Vakhtang Putkaradze (Mathematics) & Tony Maciejewski (Electrical & Computer Engineering)

2009 **Master of Science, Mathematics**
Colorado State University, Fort Collins,
Applied Mathematics
Advisor – Vakhtang Putkaradze

2004 **Bachelor of Arts, Liberal Arts**
Colorado State University, Fort Collins
- Minor in Mathematics, Minor in History

Students & mentees

Undergraduate research mentees and projects – UWEC (2017-)

Anika Rix — Exposition and Models for Nil Geometry. 2022-2023
Morgan Fiebig & Caden Joergens — Skeletons of algebraic surfaces in Grasshopper. 2022-2023
Danya Morman — Examples and documentation for assemblable surfaces. 2022.
Caden Joergens — Assemblable Algebraic Surfaces. 2021-2022
Mike Mumm — Implementing Straight-Line Programs in Bertini 2. 2021
Samantha Maurer & William O'Brien — A 3D printed Arduino powered electronic Barth Sextic. 2020
Foong Min Wong — Singularity-Aware Solidification of Algebraic Surfaces. 2019.
Foong Min Wong — 3D stereoscopic animations of algebraic surfaces using Bertini real and Blender through Python. 2019.
Foong Min Wong & Dan Hessler — Visualization of Algebraic Surfaces
Using Python and Bertini_real. 2018-2019.
Sarah Ericson & Dan Hessler — Application of machine learning to NAG. 2017-2018.
Foong Min Wong & David Bachmeier — A 3D printed gallery of algebraic surfaces. 2017-2018.

Undergraduate research mentees and projects – Notre Dame (2014-2017)

Michael Padala – Porting Bertini_real to Windows under Cygwin
Pierce Cunneen – Importing data from Bertini_real to Python
Elizabeth Sudkamp – Documentation, symbolics for Bertini_real
Nicole Ho – Porting Bertini_real visualization to Python
Chris Lembo – Documentation, examples, and videos for Bertini_real
Travis Wert – User-supplied critical point sets
Sam Cavender – Usability and tuning of Bertini_real
Alex Sievern – Porting Bertini_real to the CMake build system

Courses Taught

Courses of record

Computing in Python: Fundamentals and Procedural Programming, DS150, UWEC, Fall 2022-Spring 2023

Calculus I, Math114, UWEC, Spring 2019, Spring 2020-Spring 2023

Complex Variables, Math318, UWEC, Spring 2022

Programming for Data Science, DS710, UWEC, Fall 2017-Fall 2018, Fall 2019-Summer 2022, Spring 2023-Summer 2023

Introduction to Differential Geometry, Math338, UWEC, Spring 2019

Topological Data Analysis – Independent Study, Math399, UWEC, Fall 2017

Probability and Mathematical Statistics, Math345, UWEC, Fall 2017

Advanced Scientific Computing, Notre Dame, Spring 2017

Scientific Computing, Notre Dame, Fall 2014, Spring 2015, Fall 2015, Spring 2016, Fall 2016

Math Methods II, Notre Dame, Fall 2015

Calculus I for Life and Management Sciences, North Carolina State, Summer 2015

Computational Math for Life & Management Sciences, North Carolina State, Summer 2015

Calculus III for Scientists and Engineers, Colorado State, Fall 2013, Fall 2010

Calculus I for Scientists and Engineers, Colorado State, Fall 2008

Calculus I for Biological Scientists, Colorado State, Fall 2007, Spring 2008, Summer 2009

Informal instruction

AMS Short Course on Numerical Algebraic Geometry, JMM 2023

AMS Short Course on Mathematics and 3d printing, JMM 2022

Git for mathematicians, Illustrating Mathematics, Fall 2019; Nonlinear Algebra, Fall 2018 (ICERM Semester Programs)

Student research presentations (selected)

(Student names **in bold**)

- **C. Joergens**, S. Amethyst. "Assembling Algebraic Surfaces" at CERCA 2022, UWEC.
- **S. Maurer**, S. Amethyst. "A 3D printed Arduino-powered electronic Barth Sextic" at JMM 2022, Seattle, WA.
- **F.M. Wong**, S. Amethyst. "3D Visualization of Algebraic Surfaces Using Bertini real, Python and Blender" at JMM 2020, Denver, CO.

- **F.M. Wong**, S. Amethyst. "3D Visualization of Algebraic Surfaces Using Bertini real, Python and Blender" at CERCA 2019, UWEC.
- **F.M. Wong**, D. Bachmeier, S. Amethyst. "3D Printing Herwig Hauser's Gallery of Algebraic Surfaces with Bertini_real" at SIAM AN18, Portland, OR.
- **D. Hessler**, S. Ericson, S. Amethyst. "Using Machine Learning to Control a Path Tracker" at SIAM AN18, Portland, OR.
- **F.M. Wong, D. Bachmeier**. "3D Printing Herwig Hauser's Gallery of Algebraic Surfaces with Bertini_real". Poster at CERCA 2018, UWEC.
- **D. Hessler, S. Ericson**. "Application of Machine Learning to Numerical Algebraic Geometry" Poster at CERCA 2018, UWEC.
- **F.M. Wong, D. Bachmeier**, S. Amethyst. Presented prints at GeekCon 2017, UWEC.

Service & Honors

(∞ denotes current ongoing activity)

Institution Building

∞ Co-host, UW System Intersectional Feminist Leadership Working Group. Fall 2020-Spring 2022

∞ Queer and Trans Action Committee Member. UWEC, September 2017-

∞ Program Affiliate. Race, Ethnicity, Gender and Sexuality Studies (REGSS) Department. Spring 2019-

Member, College of Arts and Science EDI Workgroup. Fall 2021-Spring 2023

Member, Womxn Uniting and Fighting coalition. Fall 2020-Spring 2021

Lobbied for better campus communication regarding sexual assault. UWEC. Spring 2021

Lobbied to increase Covid-19 safety. UWEC. Fall 2020

Persistent and driven efforts to improve the transparency, clarity, and usefulness of the UWEC Covid Dashboard. Fall 2020-Fall 2021

Equity, Diversity, and Inclusion (EDI) Rapid Action Task Force Member *UWEC*, December 2019 - January 2020

Postdoc Focus Group *Notre Dame*, 2014 - 2015

Graduate Student Representative *Colorado State University*, 2011 - 2012, *Mathematics Department*
- Graduate student liaison on graduate committee; coordinated recruitment day.

Leadership

∞ **Senator-at-large** *University Senate*, UWEC
Fall 2021-

- **Committee member** *Campus Infrastructure Committee*, UWEC
  Fall 2022-
- **Vice President** *United Faculty and Staff*, AFT Local 6481
  Fall 2021-
- **President** *Historic Randall Park Neighborhood Association*,
  August 2020-
- **Representative** *Eau Claire Neighborhood Association*,
  March 2023-

Faculty Advisor, LIT Chapter: Leaders Igniting Transformation *UWEC*, Spring 2020-Fall 2022

Faculty Advisor, MakeUWEC *UWEC*, Fall 2017-Spring 2018

Serving my community

- **Poll worker** *Eau Claire City Elections*, Fall 2020-
- **Math Department Departmental Personnel Committee** *UWEC*, Fall 2022-
- **Math Department Scholarship Committee Member** *UWEC*, Fall 2018-
- **QTAC Scholarship Committee Chair** *UWEC*, Fall 2022-
- **Volunteer at Annual Math Meet** *UWEC*, 2017-

Volunteer at Annual Sonya Kovalevsky Day *UWEC*, 2017-2022

University of Wisconsin System Women and Science (WaS) Program Member *UWEC*, January 2020-January 2021

Q'nnect Faculty Member *UWEC*, Fall 2017-Spring 2022

Tutor and Assistant *Riverbend Math Center*, 2014 - 2015
- Free tutor and teacher for students of all ages.

Science Fair Judge *Indiana Regional Science Fair*, 2015

Poster Judge *NCSU Undergraduate Research Symposium*, 2014

Poster and Presentation Judge *Colorado State University*, 2013
"Celebrate Undergraduate Research and Creativity"

Serving my discipline

Teacher *JMM 2023*, AMS Short Course on Numerical Algebraic Geometry, January 2023

Teacher *JMM 2022*, AMS Short Course on Mathematics and 3d printing, January 2022

Software PC Member *International Symposium on Symbolic and Algebraic Computation (ISSAC)*, Summer 2020

Teacher *ICERM*, Minicourse in `git`, Fall 2019, Fall 2018

CoPresenter *ICERM*, Session on mathematical illustration with OpenSCAD, Fall 2019

PC Member *MACIS2017*, Vienna, November 2017

Session Organizer *SIAM AG17*, Atlanta, August 2017
- Applications of Numerical Algebraic Geometry in Math, Science, and Engineering

Conference Co-organizer *Polynomials, kinematics and robotics – a conference honoring Charles Wampler*
- Notre Dame, June 2017

Panel Member *Mentoring*, Notre Dame, January 2017
- Graduate student ethics training

Session Co-organizer *JMM 2017*, Atlanta, January 2017
- Theory and Applications of Numerical Algebraic Geometry (Special Session #62)

Session Co-organizer *ICMS 2016*, Berlin, July 2016
- Software for Numerically Solving Polynomial Systems.

Session Co-organizer *SIAM AN16*, Boston, July 2016
- Structured Polynomial Equations and Applications.

Conference Co-organizer *Software and Applications of Numerical Algebraic Geometry*
- Notre Dame, May 2016

Minisymposium Co-organizer *SIAM AG 15*, Daejeon, Korea, 2015
- Software and Applications in Numerical Algebraic Geometry.

Session Co-organizer *AMS Fall Western Sectional*, San Francisco, 2014
- Computational Algebraic Geometry and Applications in Science and Engineering.

Awards

- ⋆ **Karlgaard Award for Faculty Excellence, UWEC** *Fall 2022*
- ⋆ **P.B. Poorman Award for Outstanding Achievement on Behalf of LGBTQ People** *November 2019*
- ⋆ **Eagle Scout** *Troop 96, Longs Peak Council*, 1997
  - Leadership training, held all leadership positions. Once an Eagle, always an Eagle.

Grants

- ⋆ UWEC Student-Faculty Research Collaboration – "Exposition and Models for Nil Geometry". September 2022 - May 2023. $2400
- ⋆ UWEC Student-Faculty Research Collaboration – "Skeletons of algebraic surfaces in Grasshopper". September 2022 - May 2023. $4600
- ⋆ UWEC Summer Research Experiences for Undergraduates – "Examples and documentation for assemblable surfaces". Summer 2022. $4600
- ⋆ UWEC Student-Faculty Research Collaboration – "Assemblable algebraic surfaces". September 2021 - May 2022. $2400

- ⋆ UWEC Student-Faculty Research Collaboration – "Implementing Straight-Line Programs in Bertini 2". Summer 2021. $4600
- ⋆ UWEC Summer Research Experiences for Undergraduates – "A 3D printed Arduino powered electronic Barth Sextic". Summer 2020. $4600
- ⋆ UWEC Student-Faculty Research Collaboration – "Singularity-Aware Solidification of Algebraic Surfaces". Fall 2019. $2800
- ⋆ UWEC Summer Research Experiences for Undergraduates – "3D stereoscopic animations of algebraic surfaces using Bertini real and Blender through Python". Summer 2019. $4720
- ⋆ UWEC Student-Faculty Research Collaboration – "Visualization of Algebraic Surfaces Using Python and Bertini_real". September 2018 - May 2019. $2400
- ⋆ UWEC Student-Faculty Research Collaboration – "Application of machine learning to numerical algebraic geometry". May 2018 - September 2018. $4600
- ⋆ UWEC Student-Faculty Research Collaboration – "Application of machine learning to numerical algebraic geometry". September 2017 - May 2018. $2400
- ⋆ UWEC Student-Faculty Research Collaboration – "A 3D printed gallery of algebraic surfaces". September 2017 - May 2018. $1800
- ⋆ NSF DMS 1547743
  "Workshop on Software and Applications of Numerical Algebraic Geometry"
  September 1, 2015 - August 31, 2016
  $19,020 PI: Hauenstein, co-PI: **Amethyst**, Sommese, and Wampler

Publications

My name has been canonicalized to S. Amethyst

The symbol ⋆ denotes a publication with undergraduate student(s)

Accepted / Appeared

- KM. Nam, B. Gyori, S. Amethyst, D. Bates, J. Gunawardena, "Robustness and parameter geography in post-translational modification systems". PLOS Computational Biology, 2020.
- S. Amethyst, N. Daleo, J. Hauenstein, S. Sherman. "Solving critical point conditions for the Hamming and taxicab distances to solution sets of polynomial equations." ISSAC 2019.
- ⋆ T. Wert, S. Amethyst. "3d printing solid mobius surfaces." Minnesota J. Undergrad Math. 2019
- S. Amethyst, J. Hauenstein, FO. Schreyer, A. Sommese, and M. Stillman. "Singular value decomposition of complexes." SIAM Journal on Applied Algebraic Geometry 2019.
- S. Amethyst, J. Hauenstein, C. Vinzant. "Computing complex and real tropical curves using monodromy." JPAA, 2019.

- S. Amethyst, J. Hauenstein, M. Regan. "polytop: Software for computing topology of smooth real surfaces." International Congress on Mathematical Software, 2018.
- D. Bates, S. Amethyst, and M. Niemerg. "Paramotopy: Parameter homotopies in parallel." International Congress on Mathematical Software, 2018.
- M. Zarei, A. Kalhor, and S. Amethyst. "Arc length based maximal lyapunov functions and domains of attraction estimation for polynomial nonlinear systems." Automatica, 2018.
- S. Amethyst, D. Bates, W. Hao, J. Hauenstein, A. Sommese, C. Wampler. "`Bertini_real`: Numerical decomposition of real algebraic curves and surfaces." ACM ToMS, 2017.
- S. Amethyst, J. Hauenstein, A. Murray, D. Myszka, C. Wampler. "The complete solution of Alt-Burmester synthesis problems for four-bar linkages." ASME JMR, 2016.
- S. Amethyst, J. Hauenstein, A. Liddell. "Validating the Completeness of the Real Solution Set of a System of Polynomial Equations." ISSAC, Waterloo, Canada. July 2016.
- S. Amethyst, J. Hauenstein, A. Liddell. "Decomposing Solution Sets of Polynomial Systems Using Derivatives." ICMS, Berlin, Germany. July 2016.
- S. Amethyst, D. Bates, V. Putkaradze, A.A. Maciejewski. "Workspace Multiplicity and Fault Tolerance of Cooperating Robots." Accepted to *Mathematical Aspects of Computer and Information Sciences (MACIS)*, Berlin, Germany. November 2015.
- S. Amethyst, J. Hauenstein, A. Sommese. "Numerical Local Irreducible Decomposition." *MACIS*, Berlin, Germany. November 2015.
- D. Bates, S. Amethyst, W. Hao, J. Hauenstein, A. Sommese, C. Wampler. "Bertini_real: Software for One- and Two-Dimensional Real Algebraic Sets." *International Congress on Mathematical Software (ICMS)*, Seoul, South Korea. August 2014.
- D. Bates, S. Amethyst, J. Hauenstein, A. Sommese, C. Wampler. "On Computing a Cell Decomposition of a Real Surface Containing Infinitely Many Singularities." *ICMS*, Seoul, South Korea. August 2014.
- S. Amethyst, V. Putkaradze. "Reduced Systems for Intrinsic Localized Modes on an Infinite Oscillator Array." *Nonlinear Theory and Its Applications (NOLTA), IEICE*, 2013.
- S. Amethyst, H. Xu, A. Hollowell, G. Balakrishnan, C. Hains, M. Marconi, V. Putkaradze. "Intrinsic Localized Modes in Two-Dimensional Vibrations of Crystalline Pillars and Their Application for Sensing." *Journal of Applied Physics*, 2012.
- S. Amethyst, V. Putkaradze. "Simplified Models for Intrinsic Localized Mode Dynamics." *NOLTA 2012*, Palma de Mallorca, Spain, October 2012.
- S. Amethyst, V. Putkaradze. "Intrinsic Localized Modes in Two-Dimensional Vibrations of Crystalline Pillars." *NOLTA 2011*, Kobe, Japan, September 2011.
- S. Amethyst, D. J. Bates, V. Putkaradze, and A. A. Maciejewski. "Illustration of Numerical Algebraic Methods for Workspace Estimation of Cooperating Robots After Joint Failure." *IASTED Technology Conferences*, Pittsburg, PN USA, November 2010.

Submitted

⋆ S. Amethyst, S. Maurer, W. O'Brien. "A 3D printed Arduino-powered interactive Barth Sextic" Submitted 2022. Accepted, awaiting publication.

- S. Amethyst, J.D. Hauenstein, C.W. Wampler. "Cellular decompositions and Chebyshev interpolants for real algebraic curves" Submitted 2022. Under revision.

Shows and displays (selected)

Display ○ Geekcon 2022. *UWEC*. Mathematical art

Display ○ Geekcon 2021. *UWEC*. Interactive 3d models

Display ○ Cancelled due to COVID19: 2nd Annual Mathapalooza! Art Show 2020. *Georgia Tech*. 3d models

Display ○ Geekcon 2019. *UWEC*. Snap-together Barth Sextics

Juried show ○ Math+Art Exhibit. *The Granoff Center at Brown University*. 78 paths to a sphere

Display ○ Geekcon 2018. *UWEC*. 3d printed algebraic surfaces

Talk ○ "Techniques for real solutions to nonlinear algebraic systems". *ICERM Semester Program on Nonlinear Algebra*, Providence. September 2018.

Display ○ Geekcon 2017. *UWEC*. Makerspace and 3d model gallery

Show ○ **Museum Display** *South Bend Center for History*, 2014 - 2015
"150 Years of Science at Notre Dame"
- 3D printed models of singular surfaces.

Presentations (selected)

○ "Printing algebraic surfaces". *Invited talk*, Exeter Geometry Club. May 2022.

○ "Augmenting 3d printed objects for interactivity". *AMS Short Course*, JMM 2022. January 2022.

○ "My identity as a mathematical artist". *Invited talk*, Bay Area Mathematical Adventures. April 2021.

○ "Theory and Applications of Numerical Algebraic Geometry". *Invited talk*, TU Wien. October 2020.

○ "Printing Algebraic Geometry". *LG&TBQ 2019*, Ann Arbor. June 2019.

○ "Multiprecision – solving and causing problems". *Invited talk*, CUNY. March 2019.

○ "Numerical challenges to successful decomposition of real algebraic surfaces". *SIAM AG17*, Atlanta. August 2017.

○ "Regularizing Numerical Cell Decompositions". *JMM 2017*, Atlanta. January 2017.

○ "Printing Algebraic Geometry". *Bertini Workshop*, Notre Dame. May 2016.

○ "The Development of Bertini 2". *Bertini Workshop*, Notre Dame. May 2016.

- "The Complete Solution of Alt-Burmester Synthesis Problems for Four-bar Linkages". *AMS Spring Sectional*, UGA. March 2016.
- "Numerical Local Irreducible Decomposition". *MACIS*, Berlin. November 2015.
- "Workspace Multiplicity and Fault Tolerance of Cooperating Robots". *MACIS*, Berlin. November 2015.
- "Applications of Monodromy". *Algebraic Geometry Seminar*, NC State. October 2015.
- "Advances in Software in Numerical Algebraic Geometry". *SIAM Algebraic Geometry*, Daejeon, Korea. August 2015.
- "Applications of Real Algebraic Varieties to Tropical Geometry". *AMA Meeting*, Colorado College. April 2015.
- "3D Printing Mathematical Surfaces". *Notre Dame Research Symposium*, Notre Dame. April 2015. First place in poster competition.
- "Parametrized Polynomial Systems, and Real Numerical Algebraic Geometry". *Applied Math Seminar*, University of Notre Dame. March 2015.
- "Applications of Real Algebraic Varieties". *AMS Spring Sectional*, Michigan State University. March 2015.
- "Numerical challenges to decomposition of algebraic surfaces". *Seminar at the School for Computing,* DePaul University. January 2015.
- "Numerically decomposing algebraic surfaces with an infinite number of singularities". *Topology, Geometry, & Data Seminar,* Ohio State University. November 2014.
- "Printing Algebraic Surfaces with Singularities". *AMS Fall Western Sectional,* San Francisco State University. October 2014.
- "Bertini_real: software for real algebraic sets". *Solving Polynomial Equations,* The Simons Institute for the Theory of Computing. October 2014.
- "Bertini Real: real algebraic curve and surface cellular decomposition software". *International Congress of Mathematical Software,* Hanyang University. August 2014.
- "Bertini_real – Numerical surface decomposition". *East Coast Computer Algebra Day,* Duke University. April 2014. First place in poster competition.
- "A study in multistability, and criticality of real algebraic sets". *Symbolic Computation,* North Carolina State University. April 2014.
- "From polynomials to 3D printing – How to print an algebraic surface". *SUM Series,* North Carolina State University. February 2014.
- "`Paramotopy`: Parallel parameter homotopy through Bertini". *SIAM AG13.* Colorado State University. August 2013.
- "Simplified models for Intrinsic Localized Mode dynamics". *NOLTA 2012.* Palma de Mallorca, Spain. October 2012.
- "Nano oscillator array intrinsic localized mode pinning and travel". *DTRA Technical Review*, Washington, DC. July 2012.

- "Nanocrystal detectors – simulation and analysis". *Greenslopes Seminar.* Colorado State University. February 2012.
- "Intrinsic localized modes in nanocrystalline arrays". *NOLTA Workshop 2011*, Kyoto, Japan. December 2011.
- "ILM formation in arrays of nonlinearly coupled bidirectional crystal oscillators". *DTRA Technical Review 2011*, Washington, DC. July 2011.
- "Workspace estimation of cooperating robots after joint failure". *SIAM Conference on Dynamical Systems, DS2011*, Snowbird. May 2011.
- "Vibrating crystals, failing robots, and Polysaurus". *Greenslopes Seminar,* Colorado State University. April 2011.
- "Illustration of numerical algebraic methods for workspace estimation of cooperating robots after joint failure". *Greenslopes Seminar,* Colorado State University. October 2010.
- "Foam elasticity". *Greenslopes Seminar,* Colorado State University. February 2010.

Distributed Software Products

Bertini_real – Software for real algebraic sets. `bertinireal.com`
Command line software for performing numerical cellular decomposition of real algebraic curves and surfaces, with singularities, in any dimension.

Bertini 2 `github.com/bertiniteam/b2`
Homotopy continuation polynomial system solver with Python bindings, scripting, and symbolic engine. Collaborative NSF-funded project.

Bertini_tropical `silviana.org/tropical`
Matlab software for decomposing real and complex tropical curves in any number of dimensions. Interfaces with Bertini for numerical solving.

Paramotopy – Parameter homotopies in parallel. `paramotopy.com`
Command line software for rapidly solving discretized parametrized polynomials