Michael DiPasquale

Contact Information

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Research Interests

Computational commutative algebra and algebraic geometry. Emphasis on pure and applied problems which can be approached with the tools of algebraic geometry and commutative algebra.

Education

University of Illinois Urbana-Champaign (UIUC), Urbana, IL
Ph.D., Mathematics, May 2015
Advisor: Professor Hal Schenck
Thesis: Splines on polytopal complexes
Wheaton College, Wheaton, IL
B.S., Mathematics, May 2009

Academic Appointments

University of South Alabama (USA), Mobile, AL
Assistant Professor August 2021 -
Colorado State University (CSU), Fort Collins, CO
Postdoctoral Fellow August 2018 - July 2021
Oklahoma State University (OSU), Stillwater, OK
Visiting Assistant Professor August 2015 - May 2018

Publications

22. *A lower bound for the dimension of tetrahedral splines in large degree* (with N. Villamizar), to appear in Constr. Approx. arXiv:2007.12274
21. *A homological characterization for freeness of multi-arrangements*, Math. Ann. (2022) doi:10.1007/s00208-021-02357-6. arXiv:1806.05295
20. *On resurgence via asymptotic resurgence* (with B. Drabkin), J. Algebra. 587 (2021), 64-84. arXiv:2003.06980
19. *Koszul multi-Rees algebras of principal L-Borel Ideals* (with B. Jabbar Nezhad), J. Algebra. 581 (2021), 353-385. arXiv:2008.09565
18. *A lower bound for splines on tetrahedral vertex stars* (with N. Villamizar), SIAM J. Appl. Algebra Geom. 5 (2021), no. 2, 250-277. arXiv:2005.13043
17. *Counting the dimension of splines of mixed smoothness: A general recipe, and its application to meshes of arbitrary topologies.* (with D. Toshniwal), Adv. Comput. Math. (2021) arXiv:2001.01774
16. *On the apolar algebra of a product of linear forms* (with Z. Flores and C. Peterson). In *Proceedings of the 45th International Symposium on Symbolic and Algebraic Computation*, ISSAC '20, pages 130-137, New York, NY, USA, 2020. Association for Computing Machinery, arXiv:2002.04818
15. *A Generalization of Wilf's Conjecture for Generalized Numerical Semigroups* (with C. Cisto, G. Failla, Z. Flores, C. Peterson, and R. Utano), Semigroup Forum 101 (2020). arXiv:1909.13120
14. *Bivariate Semialgebraic Splines* (with F. Sottile), J. Approx. Theory 254 (2020), 105392, 19 pp. arXiv:1905.08438
13. *Free and non-free multiplicities on the A_3 arrangement* (with C. Francisco, J. Mermin, and J. Schweig), J. Algebra 544 (2020), 498-532. arXiv:1609.00337
12. *Asymptotic resurgence via integral closures* (with C. Francisco, J. Mermin, and J. Schweig), Trans. Amer. Math. Soc. 372 (2019), no. 9, 6655-6676. arXiv:1808.01547
11. *The Rees algebra of a two-Borel ideal is Koszul* (with C. Francisco, J. Mermin, J. Schweig, and G. Sosa), Proc. Amer. Math. Soc. 147 (2019), no. 2, 467-479. arXiv:1706.07462
10. *Free multiplicities on the moduli of X_3* (with M. Wakefield), J. Pure Appl. Algebra 222 (2018), no. 11, 3345-3359. arXiv:1707.03961

9. *Inequalities for free multi-braid arrangements*, Proc. Japan Acad. Ser. A Math. Sci. 94 (2018), no. 4, 36-41. arXiv:1705.02409
8. *Dimension of mixed splines on polytopal cells*, Math. Comp. 87 (2018), no. 310, 905-939. arXiv:1411.2176
7. *Semialgebraic splines* (with F. Sottile and L. Sun), Comput. Aided Geom. Design 55 (2017), 26-47. arXiv:1604.05947
6. *Generalized splines and graphic arrangements*, J. Algebraic Combin. (2016), 1-19. arXiv:1606.03091
5. *Associated primes of spline complexes*, J. Symb. Comput. (2016), 158-199. arXiv:1410.6894
4. *Lattice-supported splines on polytopal complexes*, Adv. in Appl. Math. 55 (2014), 1-21. arXiv:1312.3294
3. *Shellability and freeness of continuous splines*, J. Pure Appl. Algebra. 216 (2012), 2519-2523.
2. *Asymptotic connectivity of hyperbolic planar graphs* (with P. Bahls), Discrete Math. 310 (2010), 3462-3472.
1. *On the order of a group containing nontrivial Gassmann equivalent subgroups*, Rose-Hulman Undergraduate Mathematics Journal 10, Issue 1 (2009).
0. *Splines on polytopal complexes.* Thesis (Ph.D.) University of Illinois at Urbana-Champaign (2015). 148 pp. ISBN: 978-1339-32551-4, ProQuest LLC.

Under review

3. *Geometric aspects of the Jacobian of a hyperplane arrangement* (with J. Sidman and W. Traves), submitted. arXiv:2209.04929
2. *Duality for asymptotic invariants of graded families* (with T. Nguyen and A. Seceleanu), submitted. arXiv:2208.11110
1. *Quasi-polynomial growth of numerical and affine semigroups with constrained gaps* (with B. Gillespie and C. Peterson), submitted. arXiv:2208.09760

External Grants

NSF standard grant DMS-2201084 (2022-2025)
AMS-Simons travel grant (2015-2018)

Internal awards

USA Support and Development Award (2022)
$1500 for bringing collaborators and speakers to USA
USA Faculty Development Council Fellow (2022)
$5000 for research collaboration and development of external grant application

Teaching Experience

Instructor of record

Course	**Description**
Intro to Abstract Algebra (CSU, USA)	group theory and proof writing
Intro to Math Reasoning (CSU)	proof writing
Linear Algebra (CSU, USA)	matrix theory
Precalculus Trigonometry (USA)	trigonometric functions and modeling
Finite Mathematics (USA)	probabilities, counting, and logic for non-math majors
Intro to Combinatorial Theory (CSU)	combinatorics and number theory
Calculus 2 (CSU, USA)	sequences, series, and integration techniques
Intro to Real Analysis (OSU)	proof writing and real analysis
Calculus 1 (OSU)	differential and integral calculus
A Mathematical World (UIUC)	survey course emphasizing applications of mathematics
College Algebra (UIUC)	calculus preparation course

- Responsible for lecturing, grading exams and quizzes, writing worksheets and homework
- Wrote exams for most courses
- Often implemented group work at least once per week

Recitation instructor, University of Illinois Urbana-Champaign
- Led bi-weekly 50-minute problem sessions and proctored and graded quizzes and exams for seven semesters of Calculus (1,2, and 3)
- Led student groups through worksheets I had written during bi-weekly two-hour workhsops for one semester of Calculus 1 in the Merit program
- Appeared on the 'List of Teachers Ranked as Excellent' by their students in three semesters

Undergraduate teaching assistant, Wheaton College
- Led problem sessions once per week at Wheaton College for Analysis I, Algebra I, and Discrete Mathematics

Students supervised

Masters thesis advisor for Ryann Firestine (2022-2023)

Mentoring

Assistant for a minicourse on Algebraic Geometry at SMI in Perugia — Summer 2019
Created problem sets and ran Macaulay2 help sessions twice per week.

Honors option for Intro to Math Reasoning, Linear Algebra, Calculus 2 — Fall 2019, 2020, 2022
Created additional problem sets and problem sessions for students to receive honors credit.

Mentor in the Illinois Geometry Lab — Spring 2014, Fall 2014
Co-led undergraduate research on minimal energy configurations of particles.

Teaching mentor for junior graduate students — Fall 2013
Mentored several first-year graduate students, visited classes and offered teaching feedback.

Dissemination of Research

Lead co-author of the package AlgebraicSplines for the computer algebra system Macaulay2. This package is currently used by several researchers, including Julianna Tymoczko, who employs this package in research with undergraduates at Smith College.

Conference Presentations

1. *Curves passing through space points and Waring rank* — 01/2023
   Joint Mathematics Meetings, Boston, MA
   AMS Special Session on Applied Enumerative Geometry
2. *Homogeneous trivariate splines on the star of a vertex* — 09/2022
   INdAM Meeting in Cortona, Italy
   Approximation Theory and Numerical Analysis meet Algebra, Geometry, Topology
3. *Duality for sequences associated to symbolic powers* — 05/2022
   AMS Sectional Meeting, Denver, CO (virtual due to COVID-19)
   Special Session on Commutative Algebra
4. *Saturating the Jacobian ideal of a line arrangement and parallel drawings* — 3/2022
   AMS Sectional Meeting, Purdue, IN (virtual due to COVID-19)
   Special Session on Combinatorial Techniques in Commutative Algebra
5. *Rigidity, formality, and syzygies of the module of derivations of a line arrangement* — 10/2021
   AMS Sectional Meeting, Albuquerque, NM (virtual due to COVID-19)
   Special Session on Hyperplane arrangements in connection with commutative algebra
6. *Curves passing through points in projective space* — 10/2021
   AMS Sectional Meeting, Omaha, NE (virtual due to COVID-19)
   Special Session on Commutative Algebra
7. *Continuous splines on cross-cut cells and rigid planar frameworks* — 08/2021
   SIAM Conference on Applied Algebraic Geometry (virtual due to COVID-19)
   Minisymposium on Algebraic Methods for Multivariate Splines and Rigidity
8. *Koszul multi-Rees algebras arising from principal Borel ideals* — 03/2021
   AMS Sectional Meeting, Providence, RI (virtual due to COVID-19)
   Special Session on Current Trends in Combinatorial Commutative Algebra

9. *Dual sequences arising from apolarity* 03/2021
   AMS Sectional Meeting, Atlanta, GA (virtual due to COVID-19)
   Special Session on Commutative Algebra and its Interaction with Algebraic Geometry and Combinatorics
10. *Formal line arrangements and rigid planar frameworks* 01/2021
    Mathematisches Forschungsinstitut Oberwolfach, Germany (virtual due to COVID-19)
    Workshop on Logarithmic Vector Fields and Freeness of Divisors and Arrangements
11. *Regularity of uniform power ideals and the Waldschmidt constant* 10/2020
    AMS Sectional Meeting, University Park, PA (virtual due to COVID-19)
    Special Session on Commutative Algebra and Connections to Algebraic Geometry and Combinatorics
12. *On the apolar algebra of a product of linear forms* 07/2020
    The 45th International Symposium on Symbolic and Algebraic Computation, ISSAC '20 (virtual due to COVID-19)
13. (**Cancelled due to COVID-19**) *Generalizing Wilf's conjecture to higher dimensions* 05/2020
    AMS Sectional Meeting, Fresno, CA
    Special Session on Numerical Semigroups and Applications
14. (**Cancelled due to COVID-19**) *A linear bound on the regularity of power ideals* 04/2020
    AMS Sectional Meeting, West Lafayette, IN
    Special Session on Combinatorial Techniques in Commutative Algebra
15. *A generalization of Wilf's Conjecture* 01/2020
    AMS-MAA Joint Mathematics Meetings, Denver, CO
    AMS Special Session on Recent Trends in Semigroup Theory
16. *Apolarity and trivariate piecewise polynomials* 08/2019
    Algebraic Spline Geometry Meeting, Swansea, United Kingdom
17. *Algebraic Approaches to Spline Theory* 07/2019
    SIAM Conference on Applied Algebraic Geometry, Bern, Switzerland
    Minisymposium on Multivariate Spline Approximation and Algebraic Geometry
18. *Asymptotic Resurgence via Integral Closure and Linear Programs* 02/2019
    Southwest Local Algebra Meeting, El Paso, TX
19. *Asymptotic Resurgence and Integral Closures* 11/2018
    AMS Sectional Meeting, Fayetteville, AR
    Special Session on Interactions Between Combinatorics and Commutative Algebra
20. *Freeness of Multi-arrangements via Acyclicity* 06/2018
    Research Institute for Mathematical Sciences (RIMS), Kyoto, Japan
    Matroids, reflection groups, and free hyperplane arrangements
21. *A Homological Approach to Freeness of Multi-arrangements* 04/2018
    AMS Sectional Meeting, Boston, MA
    Special Session on Arrangements of Hypersurfaces
22. *The Toric Ring of a Two-Borel ideal is Koszul* 01/2018
    AMS-MAA Joint Mathematics Meetings, San Diego, CA
    AMS Special Session on Combinatorial Commutative Algebra and Polytopes
23. *Freeness of Multi-Coxeter Arrangements of type A* 09/2017
    AMS Sectional Meeting, Denton, TX
    Special Session on Algebraic Combinatorics of Flag Varieties
24. *Splines on planar semi-algebraic partitions* 09/2017
    AMS Sectional Meeting, Denton, TX
    Special Session on Applicable and Computational Algebraic Geometry
25. *Algebraic Methods in Spline Theory* 08/2017
    SIAM Conference on Applied Algebraic Geometry, Atlanta, GA
    Minisymposium on Multivariate Splines and Algebraic Geometry

26. *Multi-derivations on the moduli of the X_3 arrangement* 04/2017
    AMS Sectional Meeting, Pullman, WA
    Special Session on Combinatorial and Computational Commutative Algebra and Algebraic Geometry
27. *Splines on Tetrahedral Decompositions* 05/2016
    15th International Conference on Approximation Theory, San Antonio, TX
    Minisymposium on Approximation Theory and Algebraic Geometry
28. *Generalized Splines and Graphic Multi-Arrangements* 10/2015
    AMS Sectional Meeting, Chicago, IL
    Special Session on Combinatorial and Computational Algebra
29. *Piecewise Polynomials and Regularity* 04/2015
    Mathematisches Forschungsinstitut Oberwolfach, Germany
    Workshop on Multivariate Splines and Algebraic Geometry
30. *Castelnuovo-Mumford Regularity of Mixed Spline Spaces* 01/2015
    AMS-MAA Joint Mathematics Meetings, San Antonio, TX
    Session on Commutative Algebra
31. *Regularity of Planar Splines* 04/2014
    AMS Sectional Meeting, Lubbock, TX
    Special Session on Commutative Algebra and Algebraic Geometry
32. *Regularity and Piecewise Polynomial Functions* 04/2014
    KUMUNU jr, Lincoln, NE
33. *Local Properties of Splines* 03/2014
    Southwest Local Algebra Meeting, College Station, TX
    Graduate Student Poster Session
34. *Lattice-Supported Splines on Polytopal Complexes* 01/2014
    AMS-MAA Joint Mathematics Meetings, Baltimore, MD
    AMS Special Session on Hyperplane Arrangements and Applications
35. *Lattice-Supported Bases for Polyhedral Splines* 08/2013
    SIAM Conference on Applied Algebraic Geometry, Fort Collins, CO
    Session on Approximation Theory, Geometric Modeling, and Algebraic Geometry
36. *Bivariate Continuous Splines on Polyhedral Complexes* 04/2013
    14th International Conference on Approximation Theory, San Antonio, TX
    Minisymposium on Multivariate Splines
37. *Shellability and Freeness of Continuous Splines* 10/2012
    AMS Sectional Meeting, Tulane, LA
    Special Session on Approximation Theory, Geometric Modelling, and Algebraic Geometry
38. *Exploring Gassmann Triples* 01/2009
    AMS-MAA Joint Mathematics Meetings
    Undergraduate Student Poster Session ($100 prize)

Seminar & Colloquium Talks

1. *Exploring affine semigroups* 04/2022
   Colloquium, University of Texas at Tyler, Tyler, TX (virtual due to COVID-19)
2. *A duality for sequences and its manifestation for symbolic powers* 03/2022
   Algebraic Geometry and Geometric Topology Seminar, Tulane University, New Orleans, LA
3. *Cutting up a pizza and related topics* 10/2021
   Colloquium, University of South Alabama, Mobile, AL
4. *Homogeneous trivariate splines on vertex stars* 05/2021
   Online workshop *Dimension of Multivariate Splines*, University of Rome "Tor Vergata"
5. *Wilf's conjecture and its extensions* 11/2020
   Graduate Seminar, Towson University, Towson, MD (virtual due to COVID-19)
6. *Resurgence via Asymptotic Resurgence* 08/2020
   Algebra and Geometry Seminar, Iowa State University, Ames, IA (virtual due to COVID-19)

7. *Extending Wilf's Conjecture* 10/2019
   Colloquium, University of North Carolina-Charlotte, Charlotte, NC
8. *Multi-derivations of hyperplane arrangements* 06/2019
   Mediterranea University of Reggio Calabria, Italy
9. *Combinatorics, topology, and algebra of hyperplane arrangements* 06/2019
   University of Messina, Italy
10. *Commutative Algebra and Piecewise Polynomials* 02/2018
    Colloquium, Marquette University, Milwaukee, WI
11. *Commutative Algebra and Approximation Theory* 01/2018
    Colloquium, University of Nebraska-Lincoln, Lincoln, NE
12. *Homological Obstructions to Freeness of Multi-Arrangements* 10/2017
    Geometry Seminar, Texas A&M University, College Station, TX
13. *Free Multi-Braid Arrangements and Resolutions* 03/2017
    Algebra Seminar, University of Arkansas, Fayetteville, AK
14. *Dimensions of Spline Spaces and Commutative Algebra* 11/2016
    Colloquium, Towson University, Towson, MD
15. *Two Tales of Freeness* 11/2016
    Colloquium, US Naval Academy, Annapolis, MD
16. *Multi-Derivations of Braid Arrangements* 09/2016
    Combinatorics Seminar, University of Kansas, Lawrence, KS
17. *Piecewise Polynomials and Algebraic Geometry* 04/2016
    Colloquium, University of Idaho, Moscow, ID
18. *Semialgebraic Splines* 03/2016
    Valley Geometry Seminar, University of Massachusetts, Amherst, MA
19. *Commutative Algebra meets Approximation Theory* 11/2015
    Numerical Analysis Seminar, Oklahoma State University, Stillwater, OK
20. *Commutative Algebra and Approximation Theory* 09/2015
    Colloquium, Oklahoma State University, Stillwater, OK
21. *Splines, Syzygies, and Freeness* 09/2015
    Algebra Seminar, Oklahoma State University, Stillwater, OK
22. *Regularity of Planar Splines* 09/2015
    Geometry Seminar, Texas A&M University, College Station, TX
23. *Algebraic Geometry and Approximation Theory* 02/2015
    Colloquium, University of South Florida, Tampa, FL
24. *Associated Primes of Complexes Arising in Approximation Theory* 11/2014
    Commutative Algebra Seminar, UIUC
25. *Castelnuovo-Mumford Regularity in Approximation Theory* 11/2014
    Algebraic Geometry Seminar, UIUC
26. *Lehmer's Picturesque Exponential Sums with a Twist (with Daniel Schultz)* 02/2010
    Number Theory Seminar, UIUC

Talks for Undergraduate or High School audiences

1. *Piecewise Linear Functions, Projecting Polytopes, and Equilibrium Stresses* 11/2018
   Symposium of Physics and Mathematics FCFM-IFM, Universidad Michoacana de San Nicolás de Hidalgo, Morelia, Michoacán, Mexico
2. *Explorations in Rigidity* 04/2018
   OSU Math Club, Oklahoma State University, Stillwater OK
3. *The Best Way to Divide up a Cheese* 10/2017
   High School Math Day, Oklahoma State University, Stillwater OK
4. *The Pizza Cutting Problem* 02/2017
   Stillwater High School Math Seminar, Stillwater High School, Stillwater, OK
5. *Counting Piecewise Linear Functions* 03/2016
   Center for Women in Mathematics, Smith College, Northampton, MA

6. *Jumping Dimensions and Projecting Polytopes* 12/2014
Colloquium, Bradley University, Peoria, IL
7. *Continuous Piecewise Polynomials and Static Equilibrium* 10/2014
Rose-Hulman Mathematics Seminar, Terra-Haute, IN

Professional Service

Organizer
Virtual informal seminar on topics related to splines, Fall 2020-

Co-organizer (with Hendrik Speleers and Deepesh Toshniwal)
Minisymposium on Multivariate Splines: Theory and applications at the International Conference on Approximation Theory and Beyond, Nashville, TN, May 2023.

Co-organizer (with Selvi Kara)
AMS Special Session on Current Trends in Combinatorial and Homological Commutative Algebra, Mobile, AL, November 2021.

Organizer
Postdoc Seminar at CSU, Fall 2020, Spring 2021

Co-organizer (with Nelly Villamizar)
Minisymposium on Algebraic Methods for Multivariate Splines and Rigidity at the SIAM conference on Applied Algebraic Geometry in College Station, Texas, August 2021. (**Virtual due to COVID-19**)

Co-organizer (with Nelly Villamizar)
Minisymposium on Multivariate Spline Approximation and Algebraic Geometry at the SIAM conference on Applied Algebraic Geometry in Bern, Switzerland, July 2019.

Co-organizer (with Frank Sottile)
Minisymposium on Multivariate Splines and Algebraic Geometry at the SIAM conference on Applied Algebraic Geometry in Atlanta, GA, August 2017.

Co-organizer (with Tatyana Sorokina)
Minisymposium on Approximation Theory and Algebraic Geometry at the 15th International Conference on Approximation Theory in San Antonio, TX, May 2016.

Organizer
reading seminar on *The Geometry of Syzygies* in Fall 2011, Spring 2012

Referee
Served as referee on many articles for the following journals: *Mathematische Annalen*, *Journal of Pure and Applied Algebra*, *International Journal of Algebra and Computation*, *Pacific Journal of Mathematics*, *Constructive Approximation*, *Computer-Aided Geometric Design*, *Journal of Algebraic Combinatorics*, *Graphs and Combinatorics*, *Proceedings of 15th International Conference on Approximation Theory*, *SIGMA*, *Journal of Computational and Applied Mathematics*, *Canadian Mathematical Bulletin*, *Communications in Algebra*, *Épijournal de Géométrie Algébrique*, *Advances in Applied Mathematics*, *Innovations in Incidence Geometry*, *Discrete and Computational Geometry, Arkiv för Matematik, Collectanea Mathematica*

Reviewer
Zentralblatt MATH, Mathematical Reviews

Other Awards

Bourgain Fellowship, UIUC Spring 2013
REGS Summer Fellowships, UIUC Summer 2009-2013
REU Summer Fellowships, UNC Asheville & LSU Summer 2008-2009

Conference-Specific Grants

US Junior Oberwolfach Fellows grant 01/2020
to attend MFO workshop in Oberwolfach, Germany (not used since the conference was virtual)

SIAM Early Career Travel Award 07/2019
to attend SIAM Conference on Applied Algebraic Geometry in Bern, Switzerland

Supported Participant 05/2017
at CMO Workshop on Symbolic and Ordinary Powers in Oaxaca, Mexico

Oberwolfach Liebniz Graduate Students grant 04/2015
to present at MFO workshop in Oberwolfach, Germany

AMS Student Travel Grant 04/2014
for presentation at AMS Sectional Meeting at Texas Tech

AMS Student Travel Grant 01/2014
for presentation at AMS-MAA Joint Mathematics Meetings

Student Travel Award 08/2013
to attend SIAM Conference on Applied Algebraic Geometry in Fort Collins, CO

Travel Award 04/2013
for presentation at 14th International Conference on Approximation Theory

Supported Participant 12/2012
at MSRI Workshop on Combinatorial Commutative Algebra

AMS Student Travel Grant 10/2012
for presentation at the AMS Sectional Meeting at Tulane

Supported Participant 06-07/2012
at IMA summer school in Applied Algebraic Geometry at Georgia Tech

Selected Workshops Attended

INDAM Meeting: Approximation Theory and Numerical Analysis 09/2022
meet Algebra, Geometry, Topology
Cortona, Italy

MFO workshop on Logarithmic Vector Fields and Freeness of Divisors 01/2021
and Arrangements: New perspectives and applications
Oberwolfach, Germany

Macaulay 2 workshop on coding in the computer algebra system Macaulay2 07/2017
Berkeley, CA

CMO workshop on Ordinary and Symbolic Powers of Ideals 05/2017
Oaxaca, Mexico

Macaulay2 workshop on coding in the computer algebra system Macaulay2 05/2015
Boise, ID

MFO workshop on Multivariate Splines and Algebraic Geometry 04/2015
Oberwolfach, Germany

MSRI workshop on Combinatorial Commutative Algebra 12/2012
San Francisco, CA

IMA summer school in Applied Algebraic Geometry at Georgia Tech 06-07/2012
Atlanta, GA

Professional Memberships

Society for Industrial and Applied Mathematics
Member of activity group on applied algebraic geometry

References

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