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Texas A&M University
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http://www.math.tamu.edu/∼jml
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Employment:

Clay Senior Scholar for Tensor Methods and Emerging Applications to the Physical and Data Sciences at IPAM (3 months, spring 2021)

Université Paul Sabatier, Toulouse, chaire d'excellence (visiting endowed professor) (6 months, 2022-3).

Texas A&M University, College Station, TX, professor of mathematics (8/04- present).

Chancellor's Professor at Simons Institute for Theoretical Computing/Univerisity of California at Berkeley, Berkeley, CA, (8/14-12/14).

Harvard University, invited visiting professor (7/04-12/04 and 1/22).

Georgia Institute of Technology, Atlanta, GA, associate professor (8/01 -8/04), visiting associate professor (8/00-7/01).

Université Paul Sabatier, Toulouse, Maître de conférences (9/96-7/00).

Columbia University, New York, visiting assistant professor (9/94-5/95, 1/96-5/96).

Institut des Hautes Etudes Scientifiques (IHES), visiting member (9/95-12/95).

University of Pennsylvania, Philadelphia, Hans Rademacher Instructor and National Science Foundation postdoctoral fellow (9/90-7/92, 9/93-5/94).

Institute for Advanced Study (IAS), Princeton, Visiting member and National Science Foundation postdoctoral fellow, (9/92-4/93).

Distinctions: Clay Senior Scholar for Tensor Methods and Emerging Applications to the Physical and Data Sciences at IPAM (spring 2021), U. Toulouse visiting endowed professorship "chaire d'excellence" (6 months, 2021-3) Stanford University Exceptional Teacher Tribute (2018), AMS fellow (class of 2017), UC Berkeley Chancellor's Professor (fall 2014), NSF post-doctoral fellow (1990-93).

Education:

1997: Habilitation à diriger des recherches, Université Paul Sabatier, Toulouse.
Director: Dr. Carlos Simpson.
Jury: Dr. A. Beauville, Dr. J.P. Demailly, Dr. M. Green, Dr. M. Gromov, Dr. G. Levitt, Dr. J.C. Sikorav, Dr. C. Simpson, Dr. B. Teissier, Dr. F. Zak.
Mémoire: *Géométrie algébrique et géométrie differentielle projective.*

1990: Ph.D., Duke University, Durham, NC.
Director: Dr. Robert L. Bryant.

Thesis: *Minimal submanifolds defined by first order systems of pde.*

1986: Honors Combined Sc.B. and M.S. degree, Brown University, Providence RI.
Director: Dr. Katsumi Nomizu.
Thesis: *A Gauss-Bonnet formula for Lorentzian two-manifolds.*

Areas of research: 1) Applications of algebraic geometry, differential geometry and representation theory to complexity theory, 2) Geometry of tensors and applications, 3) Exterior differential systems, 4) Geometry of projective varieties, 5) Geometry and exceptional Lie groups.

Research Grants:
National Science Foundation grant CCF-1814254 $482,511 (7/18 - 7/21)
National Science Foundation grant DMS-1405348 (7/15 - 7/18)
National Science Foundation grant DMS-1006353 (joint with C. Robles) (7/10 - 7/14)
National Science Foundation grant DMS-0805782 (joint with C. Robles) (8/08 - 7/10)
National Science Foundation grant DMS-0505216 (collab. w. V. Zharnitsky) (8/05 - 7/08)
National Science Foundation grant DMS-0305829 (sole PI) (8/03 - 7/06)
Prime d'encadrement et de recherche (French government grant) (9/99 - 9/02)
National Science Foundation grant DMS-9626640 (sole PI) (8/96 - 8/99)
National Science Foundation grant DMS-9303704 (sole PI) (7/93 - 7/96)
National Science Foundation Postdoctoral Research Fellowship (7/90-7/93)

Other Grants:
National Science Foundation grant for Texas geometry and topology conference DMS-1812040 (with D. Baskin and I. Zelenko) $90,000 (5/18 - 5/21)

National Science Foundation grant for Texas geometry and topology conference DMS-1510060 (with J.Pitts) (4/15 - 4/18)

National Science Foundation grant for New Directions in Exterior Differential Systems: A conference in honor of Robert Bryant's 60th birthday DMS-1321212 (with J. Clelland and C. Robles) (2/13 - 2/14)

National Science Foundation grant for Texas geometry and topology conference DMS-1203131 (with J.Pitts) (4/12 - 4/15)

National Science Foundation grant for Texas Algebraic Geometry Symposium DMS-1203175 (with L. Matusevich, J. M. Rojas, P. Lima-Filho, and F. Sottile) (4/12 - 4/13)

Insititue for Math and Applications (IMA) conference grant for Applications of Geometry workshop at TAMU (4/12)

National Science Foundation grant for Texas geometry and topology conference DMS-0904481 (with J.Pitts) (4/09 - 4/12)

National Science Foundation grant for Texas Algebraic Geometry Seminar DMS-0915235 (with M. Rojas, P. Lima-Filho, F. Sottile, L. Matusevich) (4/09 - 4/12)

National Science Foundation grant for Texas geometry and topology conference DMS-0605082 (with J.Pitts) (4/06 - 4/09)

Georgia Tech VIGRE grant (one of 5 PI's) (2002-2007).

Teaching experience.

Teaching at all levels in the US and France, from first year undergraduate to advanced graduate classes.

Helped modernize graduate course offerings at Texas A&M.

Initiated supplementary mathematics programs in Philadelphia city schools to spark interest in mathematics (funded by a small grant from the Executive Service Corps of Philadelphia), by giving mathematics presentations at a junior high school and a high school (91-94).

LSAMP mentor - program for first generation college students (2017-18, program discontinued after 2018).

Supervision.

Postdoctoral supervision:

A. Bik (1/22-1/23), *Post-doc mobility fellowship funded by Swiss national science foundation*

A. Huang (8/19-present)

A. Harper (8/18-present)

E. Ventura (8/17-12/19), currently at U. Bern

K. Efremenko (8/14-12/14), *funded by Simons Inst. Theoretical computing*, currently at Ben-Gurion University

C. Ikenmeyer (1/13-5/16), currently associate professor at U. Leeds

H. Kadish (8/11-8/12), currently field engineer at Tamr Inc.

A. Boralevi (8/08-7/10), currently associate professor at U. Torino

J. Buczynski (8/08-7/10), *funded by Marie Curie fellowship (European Union)*, currently at Institute of Mathematics of Polish Academy of Sciences (IMPAN) and Faculty of Mathematics, Computer Science and Mechanics of University of Warsaw (MIMUW)

Z. Teitler (8/07-7/10), currently associate professor at Boise State U.

D. The (8/08-7/11), *funded by NSERC fellowship (Canadian government)* and TAMU, currently at U. Tromso

A. Bernardi (8/06-1/07), currently associate professor at U. Trento

J. Dilles (8/06-12/07), currently lecturer at UGA, Athens.

D. Fox, (8/03-5/04), currently at Universidad Politécnica de Madrid

PhD students:

1. A. Conner, *New results in the complexity of matrix multiplication*, PhD 5/20, currently NSF postdoctoral fellow at Harvard University.

2. F. Gesmundo, *Geometry and representation theory in the study of matrix rigidity*, PhD 7/17, currently research post-doctoral fellow at U. Copenhagen.

3. C. Farnsworth, *The polynomial Waring problem and the determinant*, PhD 8/16, obtained research post-doctoral fellow at Yonsei University, Seoul, currently at U. Texas, San Marcos.

4. Y. Guan, Equations for Chow varieties, their secant varieties and other varieties arising in complexity theory, PhD 8/16, currently Computer Vision Algorithm Scientist at MINIEYE, Shenzhen, China.

5. C. Porter, *The local equivalence problem for 7-dimensional, 2-nondegenerate CR manifolds whose cubic form is of conformal unitary type*, PhD 8/16, post-doctoral fellow at North Carolina State University, currently at University of Hradec Kralove in the Czech Republic.

6. Y. Qi, *Geometry of Feasible Spaces of Tensors*. PhD 8/13. Obtained joint U. Grenoble (engineering) U. Chicago (statistics), and U. Chicago math Dickenson postdoctoral fellow. Currently advanced post-doctoral researcher at INRIA (France)

7. M. Yang, *On partial and generic uniqueness of block term tensor decompositions in signal processing*. PhD 12/12. Currently tenure track at Westfield State University.

8. K. Ye, *Immanants, tensor network states and the geometric complexity theory program*. PhD 5/12. Postdoctoral fellow at U. Chicago (joint statistics-math-computer science). Currently 10 year position as a junior member of the Chinese National Academy of Sciences.

9. L. Oeding, *Defining equations of the variety of principal minors*. PhD 5/09. NSF postdoctoral fellow at Firenze followed by RTG postdoctoral fellow at UC Berkeley, currently associate professor at Auburn Univ.

10. F. Holweck, *Singularities of hyperplane sections of homogenous varieties*. PhD 9/04 from Université Toulouse III. Currently MDC (associate professor) at U. Belfort.

11. E. Allaud, *Variation of Hodge structure viewed from an exterior differential systems perspective*. PhD 10/02 from Université Toulouse III. Postdoctoral fellowship at U. Utah. Currently teaching in Brussels.

Current PhD students: K. Bari, C. Chang, A. Pal, R. Geng.

Master's students: B. Liu 5/16, Y. Zheng 5/17

Georgia Faculty development program: M. Dillon, *Constructions of graded Lie algebras* (2001-2)

Mémoires de DEA directed:

M. Canton, *Rigidity of G-structures* (6/00)
F. Holweck, *Representation theory and geometry* (6/00)
S. Bonhomme, *Dual Varieties* (6/99)
S. Lapasset, *The Goresky-MacPherson version of Lefschetz's theorem* (6/99)
E. Allaud, *The calculus of variations after Bryant and Griffiths* (6/98)
C. Laratte, *Characteristic varieties and the Radon transform* (6/98)

Undergraduate research supervision:

P. Sarin (high school student), resulting in the article "On the geometry of Tensor Network States of 2xN Grids" (LAA 575 (2019), 235–249).

D. Allums, project resulting in the publication of "Border rank of ternary trilinear forms and the j-invariant", Involve **8** (2015), no. 2, 345-–355.

Service since 2007

TAMU math dept. subcommittee P (10/18-10/20)
TAMU math dept. Undergraduate committee (9/17-9/19)
TAMU math dept. Executive committee (9/15-9/17)
TAMU math dept. Awards committee (9/12-9/14)

AMS Committee on Academic Freedom, Tenure, and Employment Security (CAFTES) (11/08-11/11), chair of committee (2011).
TAMU math. dept. subcommittee T (10/10-10/12, head in 2011)
TAMU math dept. postdoctoral fellow committee (10/08-10/10)
TAMU math dept.graduate committee (10/06-10/08)

Organization since 2007

1. Co-organizer of the *fall 2019 Texas geometry and topology conference (TGTC)*, TAMU (11/19)

2. Co-organizer of *special session on applications of algebraic geometry and representation theory* at 2018 Spring Southeast AMS sectional meeting, Vanderbilt University (4/18)

3. Co-organizer of *Working Group on Representation Theory and GCT*, Santa Fe Institute (12/16)

4. Co-organizer of the *fall 2016 Texas geometry and topology conference (TGTC)*, TAMU (11/16)

5. Co-organizer of *Differential Geometry and its Applications conference*, and Organizer of a *special workshop on the complexity of matrix multiplication*, Brno (8/16)

6. Co-organizer of the *Algorithms and Complexity in Algebraic Geometry reunion workshop*, Simons Institute of Theoretical Computing, Berkeley (12/15)

7. Steering committee for *SIAM Algebraic Geometry activity group conference and special session organizer*, Daejeon (8/15)

8. Co-organizer of *Special semester on Algorithms and Complexity in Algebraic Geometry*, Simons Institute of Theoretical Computing, Berkeley CA (fall 2014)

9. Co-organizer of *Workshop on uses of algebraic geometry in combinatorial and computational geometry*, IPAM, Los Angeles, CA (4/14)

10. Co-organizer of *Differential Geometry and its Applications conference*, and organizer of a *special session on Geometric Complexity Theory*, Brno (8/13)

11. Co-organizer of *AMS MRC on Geometry and Representation Theory Related to Geometric Complexity and Other Variants of P v. NP*, Snowbird, UT, (6/12)

12. Co-organizer of *Questions in geometry arising in the sciences* TAMU (4/12)

13. Co-organizer of *Mathematical aspects of P v. NP and variants*, ICERM, Brown University, Providence, RI, (8/11)

14. Steering committee for: *Latin American School on Algebraic Geometry and Applications /Escuela Latinoamericana de Geometría Algebraica y Aplicaciones (ELGA 2011)* (8/11)

15. Co-organizer of the *fall 2010 Texas geometry and topology conference (TGTC)*, TAMU (11/10)

16. Steering committee for: *Tensor Decompositions and Applications (TDA 2010)* Bari (Engineering conference on tensors) (09/10)

17. Co-organizer of the *spring 2009 Texas Algebraic Geometry Seminar*, TAMU (05/09)

18. Co-organizer and teacher of MSRI summer graduate workshop, *Geometry and Representation Theory of Tensors for Computer Science, Statistics, and other areas*, (07/08)

19. Co-organizer of AIM workshop *Geometry and representation theory of tensors for computer science, statistics and other areas* (07/08)

20. Co-organizer of the *fall 2007 Texas geometry and topology festival*, TAMU (11/07)

Current seminar organization

Co-organizer and initiator of the twice weekly TAMU *Geometry seminar*
http://www.math.tamu.edu/seminars/geometry/
Organizer and initiator of the weekly TAMU *Student/Post-doc geometry seminar*, spring 2019-now twice weekly
http://www.math.tamu.edu/seminars/studentpd_geom_work/

Editorial board membership

SIGMA since 2019
FOCM since 2015
Linear algebra and its applications since 2012
Differential geometry and its applications since 2010
special issue of SIGMA, Eli Cartan and differential geometry (2008)

Membership

Member of the AMS, SIAM, and ILAS.

Publications

Research articles

1. "A geometric study of Strassen's asymptotic rank conjecture and its variants", (with Austin Conner, Fulvio Gesmundo, Emanuele Ventura, and Yao Wang), to appear in Collecteana (arXiv:1811.05511)

2. "Multilinear Compressive Sensing and an Application to Convolutional Linear Networks", (with F. Malgouyres)

   SIAM J. Math. Data Sci. **1** (2019), no. 3, 446–475.

3. "Explicit polynomial sequences with maximal spaces of partial derivatives and a question of K. Mulmuley", (with F. Gesmundo),

   Theory of Computing, **15** (2019) no. 3, pp. 1-24

4. "The geometry of rank decompositions of matrix multiplication II: 3x3 matrices", (with G. Ballard, C. Ikenmeyer, and N. Ryder),

   J. Pure Appl. Algebra **223** (2019), no. 8, 3205–3224.

5. "The geometry of rank decompositions of matrix multiplication I: 2x2 matrices", (with L. Chiantini, C. Ikenmeyer, and G. Ottaviani),

   Exp. Math. **28** (2019), no. 3, 322–327.

6. "Matrix Product States and the Quantum Max-Flow/Min-Cut Conjectures"(with F. Gesmundo and M. Walter),

   J. Math. Phys. **59** (2018), no. 10, 102205, 11 pp.

7. "On minimal free resolutions of sub-permanents and other ideals arising in complexity theory", (with K. Efremenko, H. Schenck, and J. Weyman),

   J. Algebra **503** (2018), 8–20

8. "Polynomials and the exponent of matrix multiplication", (with L. Chiantini, J. Hauenstein, C. Ikenmeyer, and G. Ottaviani),

   Bull. Lond. Math. Soc. **50** (2018), no. 3, 369–389.

9. "The method of shifted partial derivatives cannot separate the permanent from the determinant", (with K. Efremenko, H. Schenck, and J. Weyman),

   Math. Comp. **87** (2018), no. 312, 2037–2045

10. "A $2n^2 - \log_2(n) - 1$ lower bound for the border rank of matrix multiplication", (with M. Michalek),

    Int. Math. Res. Not. IMRN 2018, no. 15, 4722–4733.

11. "Permanent vs determinant: an exponential lower bound assuming symmetry and a potential path towards Valiant's conjecture", (with N. Ressayre),

    DGA special issue on geometry and complexity theory, **55** (2017), 146—166.

12. "On the complexity of the permanent in various computational models", (with C. Ikenmeyer),

    J. Pure Appl. Algebra **221** (2017), no. 12, 2911–2927.

13. "An explicit description of the irreducible components of the set of matrix pencils with bounded normal rank", (with F. De Teran and F. Dopico),

    Linear Algebra Appl. **520** (2017), 80–103.

14. "On the geometry of border rank algorithms for matrix multiplication and other tensors with symmetry"(with M. Michalek),

    SIAM J. Appl. Algebra Geom. **1** (2017), no. 1, 2–19.

15. "Abelian Tensors", (with M. Michalek),

    J. Math. Pures Appl. (9) **108** (2017), no. 3, 333–371.

16. "On the geometry of border rank algorithms for $n \times 2$ by 2×2 matrix multiplication", (with N. Ryder)

    Exp. Math. **26** (2017), no. 3, 275–286.

17. "Complexity of linear circuits and geometry ", (with F. Gesmundo, J. Hauenstein, and C. Ikenmeyer)

    FOCM **16**(2016) no. 3, 599–635.

18. "New lower bounds for the border rank of matrix multiplication", (with G. Ottaviani)

    Theory of Computing, **11** (2015), 285–298.

19. "Explicit tensors of border rank at least $2n - 1$ ",

    J. Pure and appl. Algebra, **219** (2015), no. 8, 3677—3684.

20. "Connections between conjectures of Alon-Tarsi, Hadamard-Howe, and integrals over the special unitary group ", (with S. Kumar)

    Discrete Math. **338** (2015), no. 7, 1232—1238.

21. "Geometric Complexity Theory: an introduction for geometers",

    Annali di Matematica dell'Università di Ferrara, **61** (2015), no. 1, 65-–117.

22. "New lower bounds for the rank of matrix multiplication",

    SIAM J. Comput. **43** (2014), no. 1, 144-–149.

23. "Padded polynomials, their cousins, and geometric complexity theory", (with H. Kadish),

    Comm. Algebra **42** (2014), no. 5, 2171—2180.

24. "On the third secant variety" (with J. Buczynski),

    J. Algebraic Combin. **40** (2014), no. 2, 475-–502.

25. "Equations for lower bounds on the border rank" (with G. Hauenstein and C. Ikenmeyer),

    Exp. Math. **22** (2013), no. 4, 372-–383.

26. "Determinental equations for secant varieties and the Eisenbud-Koh-Stillman conjecture" (with J. Buczynski and A. Ginesky),

    J. Lond. Math. Soc. (2) **88** (2013), no. 1, 1-–24.

27. "Equations for secant varieties of Veronese and other varietites" (with G. Ottaviani),
Ann. Mat. Pura Appl. (4) **192** (2013), no. 4, 569-–606.

28. "Fubini-Griffiths-Harris rigidity of homogeneous varieties" (with C. Robles),
Int. Math. Res. Not. IMRN **7** (2013), 1643-–1664.

29. "Hypersurfaces with degenerate duals and the Geometric Complexity Theory Program" (with L. Manivel and N. Ressayre),
Comment. Math. Helv. **88** (2013), no. 2, 469-–484.

30. "Holographic algorithms without matchgates" (with J. Morton and S. Norine),
Linear Algebra Appl. **438** (2013), no. 2, 782–795.

31. "Ranks of tensors and a generalization of secant varieties" (with J. Buczynski),
Linear Algebra Appl. **438** (2013), no. 2, 668—-689.

32. "On the geometry of Tensor Network States" (with Y. Qi and K. Ye),
Quantum Inf. Comput. **12** (2012), no. 3-4, 346–354.

33. "Fubini-Griffiths-Harris rigidity and Lie algebra cohomology" (with C. Robles),
Asian J. Math. **16** (2012), no. 4, 561-–586.

34. "An overview of mathematical issues arising in the Geometric complexity theory approach to VP $\neq$ VNP " (with P. Buergisser, L. Manivel and J. Weyman),
SIAM J. Comput. **40** (2011), no. 4, 1179—-1209.

35. "Lines on hypersurfaces" (with C. Robles),
J. London Math. Soc. (2) **82** (2010), no. 3, 733–746,

36. "On the Debarre-deJong and Beheshti-Starr conjectures on varieties with too many lines" (with O. Tommasi),
Mich. Math. J. **59** N. 3 (2010) 573–588.

37. "P versus NP and geometry"
J. Symbolic Computation, **45** (2010) 1359-–1377.

38. "On the ranks and border ranks of symmetric tensors" (with Z. Teitler),
Found. Comput. Math. **10** (2010), no. 3, 339–366.

39. "On secant varieties of Compact Hermitian Symmetric Spaces" (with J. Weyman),
Journal of Pure and Applied Algebra **213** (2009), no. 11, 2075–2086.

40. "Fubini's Theorem in codimension two" (with C. Robles),
J. Reine Angew. Math. **631** (2009), 221–235.

41. "Geometry and the complexity of matrix multiplication",
Bull. Amer. Math. Soc. (N.S.) **45** (2008), no. 2, 247–284.

42. "Differential geometry of submanifolds of projective space"
in Symmetries and overdetermined systems of partial differential equations, 105–125, IMA Vol. Math. Appl., **144** (2008)

43. "Generalizations of Strassen's equations for secant varieties " (with L. Manivel),
Comm. Algebra **36** (2008), no. 2, 405–422

44. "On the ideals and singularities of secant varieties of Segre varieties" (with J. Weyman),
Bull. Lond. Math. Soc. **39** (2007), no. 4, 685–697.

45. "Legendrian varieties" (with L. Manivel),
Asian J. Math. **11** (2007), no. 3, 341–359

46. "On Tangential varieties of rational homogeneous varieties" (with J. Weyman),
Journal Lond. Math. Soc. **76** (2007) (2), 513-530.

47. "The border rank of the multiplication of two by two matrices is seven"
J. Amer. Math. Soc. **19** (2006), no. 2, 447–459

48. "A universal dimension formula for complex simple Lie algebras" (with L. Manivel),
Advances in Math. **201** (2006), no. 2, 379–407.

49. "The sextonions and $E_{7\frac{1}{2}}$ " (with L. Manivel),
Advances in Math. **201** (2006), no. 1, 143–179.

50. "Griffiths-Harris rigidity of compact Hermitian symmetric spaces"
J. Differential Geometry **74** (2006) 395–405.

51. "On the ideals of secant varieties of Segre varieties" (with L. Manivel),
Found. Comput. Math. **4** (2004), no. 4, 397–422.

52. "On space-time coding in the presence of spatio-temporal correlation "
(with M. Fozunbal (principal author), S. McLaughlin, R. Schafer), IEEE Transactions on Information Theory **50** (2004), no. 9, 1910–1926.

53. "Series of Lie Groups" (with L. Manivel),
Michigan Math. J. **52** (2004), no. 2, 453–479

54. "Series of nilpotent orbits" (with L. Manivel and B. Westbury),
Experiment. Math. **13** (2004), no. 1, 13–29.

55. "Lines on algebraic varieties"
Journal für die reine und angewandte Mathematik (Crelle), **562** (2003) 1–3.

56. "On the projective geometry of homogeneous varieties" (with L. Manivel),
Commentari Math. Helv., **78**(2003) 65–100.

57. "Triality, exceptional Lie algebras, and Deligne dimension formulas"(with L. Manivel) ,
Advances in Mathematics **171** (2002) 59–85.

58. "Construction and classification of complex simple Lie algebras via projective geometry" (with L. Manivel),
Selecta Mathematica, **8** 137–159 (2002).

59. "On the projective geometry of Freudenthal's magic chart" (with L. Manivel),
J. Algebra, **239** 477–512 (2001).

60. "On the infinitesimal rigidity of homogeneous varieties",
Compositio Mathematica, **118** (1999) 189–201.

61. "Is a linear space contained in a submanifold? - On the number of derivatives needed to tell ",
Journal für die reine und angewandte Mathematik (Crelle) **508**(1999) 53–60.

62. "On symmetric degeneracy loci, spaces of symmetric matrices of constant rank and dual varieties " (with B. Ilic),
Mathematische Annalen, **314** (1999) 159–174.

63. "On a conjecture of Kontsevich and variants of Castelnuovo's lemma",
Compositio Mathematica **115** (1999) 231–239 and **140** (2004), no. 4, 1112..

64. "On minimal isometric embeddings" (with T. Ivey),
Duke Mathematical Journal **89**(1997) 555–576.

65. "Differential-geometric characterizations of complete intersections",
Journal of Differential Geometry **44** (1996) 32–73.

66. "On degenerate secant and tangential varieties and local differential geometry",
Duke Mathematical Journal **85**(1996) 605–634.

67. "On second fundamental forms of projective varieties",
Inventiones Math. **117**(1994) 303–315.

68. "Minimal submanifolds defined by first order systems of PDE",
Journal of Differential Geometry, **36**(1992) 369–417.

69. "Minimal submanifolds of E^{2n+1} arising from degenerate $SO(3)$ orbits on the Grassmannian",

    AMS Transactions, **325**(1991), 101–117.

Submitted research articles

1. "On the geometry of geometric rank" (with Runshi Geng) arXiv:2012.04679
2. "Bad and Good news for Strassen's laser method: Border rank of the 3x3 permanent and strict submultiplicativity" (with Austin Conner and Hang Huang) arXiv:2009.11391
3. "Towards finding hay in a haystack: explicit tensors of border rank greater than $2.02m$ in $\mathbb{C}^m \otimes \mathbb{C}^m \otimes \mathbb{C}^m$", (with M. Michalek) arXiv:1912.11927
4. "New lower bounds for matrix multiplication and the 3×3 determinant", (with Austin Conner and Alicia Harper) arXiv:1911.07981
5. "Tensors with maximal symmetries", (with Austin Conner, Fulvio Gesmundo, and Emanuele Ventura) arXiv:1909.09518
6. "Kronecker powers of tensors and Strassen's laser method", (with Austin Conner, Fulvio Gesmundo, and Emanuele Ventura) arXiv:1909.04785

Refereed Conference Proceedings

1. "Tensors not subject to barriers for Strassen's laser method", (with A. Conner, F. Gesmundo, and A. Conner)

   Innovations in Theoretical Computer Science (ITCS), 2020, Seattle, WA.

2. "Stable recovery of the factors from a deep matrix product", (with François Malgouyres)

   Signal Processing with Adaptive Sparse Structured Representations (SPARS), 2017, Lisbon, Portugal

3. "On the identifiability and stable recovery of deep/multi-layer structured matrix factorization", (with F. Malgouyres),

   IEEE Information Theory Workshop (ITW) 2016

4. "Permanent vs determinant: an exponential lower bound assuming symmetry", (with N. Ressayre),

   ITCS'16—Proceedings of the 2016 ACM Conference on Innovations in Theoretical Computer Science, 29–35, ACM, New York, 2016

Expository articles

1. "A very brief introduction to quantum computing and quantum information theory for mathematicians" (invited article), in book Quantum Physics and Geometry, UMI Springer Lecture Notes. **25** (2019) 5–41.

2. "On the geometry of matrix multiplication" (invited article).

   Notices Amer. Math. Soc. **65** (2018), **4**, 402.

3. "An introduction to geometric complexity theory" (invited article),

   Eur. Math. Soc. Newsl. **99** (2016), 10–18.

4. "Exterior differential systems, Lie algebra cohomology, and the rigidity of homogeneous varieties",

   Proceedings of the 2008 Srni Winter School in geometry and Physics, Arch. Math. (Brno) **44** (2008), no. 5, 419–447.

5. "Exterior differential systems and billiards",

   Geometry, Integrability and Quantization VII edited by Ivaïlo M. Mladenov and Allen C. Hirshfeld. 35–54, Softex, Sofia, 2006.

6. "Representation theory and projective geometry" (with L. Manivel),

   Algebraic transformation groups and algebraic varieties, 71–122, Encyclopaedia Math. Sci., 132, Springer, Berlin, 2004

7. "G-structures via three examples",

   in Web theory and related topics , Grifone, Salem, eds., World Scientific 2001, 133–150.

8. "Exterior differential systems: a geometric approach to pde",

   Proc. Workshop pure math. **17.III**(1998) pp. 77-101.

9. "Géométrie algébrique et géométrie differentielle projective",

   Pŕepublication 106 du Laboratoire E. Picard, décembre 1997. (Habilitation à diriger des recherches)

10. "On the local differential geometry of complete intersections"

    Séminaire de théorie spectrale et géométrie, Grenoble (1994-1995) pp. 1-12.

Books

1. "Introduction to quantum computation and quantum information theory for mathematicians"(draft available).

2. "Tensors: Asymptotic Geometry and Developments 2016–2018"

   CBMS lecture series, AMS, Volume: 132; 2019; 152 pp.

3. "Geometry and Complexity Theory",

   Cambridge Studies in Advanced Mathematics 169, Cambridge Univ. Press. 2017.

4. "Tensors: Geometry and Applications"

   AMS graduate studies in mathematics vol 128, 2011. 439 pages.

5. "Cartan for beginners: an introduction to the moving frame and exterior differential systems" (with T. Ivey)

   AMS graduate studies in mathematics vol 61, 2003. 378 pages. Second Edition, 471 pages, vol. 175, 2017.

6. "Algebraic geometry and projective differential geometry, Seoul National University concentrated lecture series 1997"

   Seoul National University Press (1999). 85 pages.

Research invitations

Harvard University Mathematics dept., one month (2020, postponed due to COVID19)
Harvard University Computer Science dept., one month (2020, postponed due to COVID19)
IPAN/U. Krakow , Warsaw, one month (2020, postponed due to COVID19)
MPI, Leipzig, one week (7/19)
IPAN special semester, Warsaw, two weeks (fall 2018) (Simons Visiting Professorship)
MPI, Leipzig, one week (7/18)
QMath, Copenhagen, two weeks (7/18)
Univ. Trento, two months (6-7/17)
Univ. Lyon/ENS Lyon, three weeks (6/15)
Research "in pairs", Oberwolfach Math. Inst., Germany, two weeks (11/13)
IAS (to work with CS group), one week (7/13)
Algebraic Geometry with a view towards applications, Mittag-Leffler Inst., Stockholm one month (5/11)
ANU, Canberra, 3 weeks (7/10)
U. Grenoble, France, one month (10/09)
ANU, Canberra, 3 weeks (7/09)
Institut des Hautes Etudes Scientifiques (IHES), one month (7/07)
Korean Institute for Advanced Study, Seoul, one month visiting professor (6/06)
University of Grenoble, one month visiting professor (5/04)
Korean Institute for Advanced Study, Seoul, one month visiting professor (12/00-1/01)
Mathematsche Institut, Basel, one month visiting professor (6/00)
Institut des Hautes Etudes Scientifiques (IHES) (8/99)
University of Grenoble, one month visiting professor (11/95)
Mathematical Sciences Research Institute (MSRI), four one month postdoctoral visits (1/93, 5/93, 3/94, 5/94)
University of Chicago, one month visiting professor (5/92)
University of Chicago, one month visiting professor (5/91)

Plenary or principal lectures (since 2000)

Lectures at events with more than 200 participants are marked with an asterisk.

1. GO60, pure and applied algebraic geometry (6/21)

2. ILAS, Rio de Janero (7/19)*

3. IAMCS Workshop on Quantum Computation and Information, TAMU (5/19)
4. Matrix multiplication: geometry and recent developments, Oberwolfach Complexity meeting (11/18)
5. Geometry and group actions, Warsaw (9/18)
6. Tensors: geometry and quantum information, Copenhagen (7/18)
7. Southeastern Section AMS, Vanderbilt University (4/18)*
8. SLAM, U. Arkansas (2/18)
9. Berlin-Leipzig Seminar on Algebra, Geometry and Combinatorics (10/17)
10. SIAM Algebraic Geometry meeting, Georgia Tech, Atlanta (7/17)*
11. Quantum Physics and Geometry, Levico Terme (7/17)
12. ALGECOM, Purdue University (10/16)
13. CMO Workshop: Integrability and Near-Integrability in Mechanics and Geometry, Oxaca (6/16)
14. The Classification Program of Counting Complexity workshop, Simons Inst. UC Berkeley (3/16)
15. Innovations in Theoretical Computer Science MIT, (1/15) [not a plenary talk but a competitive CS conference]
16. Simons Algebraic Geometry reunion workshop (12/15)
17. Wildness in Computer Science, Physics and Mathematics, Santa Fe Institute (10/15)
18. Optimization in machine learning, vision and image processing, CIMI Toulouse, (10/15)
19. GCT Workshop, ENS Lyon, (6/15)
20. Workshop: Tensor Low-rank Optimization and Applications, Bonn, (6/15)
21. ICRTCA conference in honor of J. Weyman, U. Conn (4/15)
22. Berlin Mathematical School Colloquim , Berlin (2/15)
23. Tensor workshop, Simons Inst. UC Berkeley (11/14)
24. Geometric Complexity Theory Workshop, Simons Inst. UC Berkeley (9/14)
25. ICERM workshop on computational multilinear algebra, Providence, RI (6/14)
26. Tools from Algebraic Geometry at IPAM, UCLA (4/14)
27. Computational Algebraic Statistics, Theories and Applications (CASTA 2014), Kyoto (1/14)

28. Quantum Marginals conference, Isaac Newton Institute for Mathematical Sciences, Cambridge UK (10/13)

29. Tensor network algorithms in computational physics and numerical analysis, ETH Zurich (5/13)

30. The interaction of geometry and representation theory: exploring new frontiers (conference in honor of 60th birthday of M. Eastwood) at ESI (Vienna) (9/12)

31. Genova-Torino-Milano seminar, Torino (6/12)

32. 17-th Conference of the International Linear Algebra Society, Braunschweig (8/11)*

33. Conformal Differential Geometry and its Interaction with Representation Theory, University of Arkansas, Fayetteville (4/11)

34. Workshop on Tensor Decompositions and Applications (TDA), Bari (9/10).

35. Differential Geometry and its Applications (DGA2010), Brno, (8/10)*

36. Mathematics and Physics on the Borderline between Algebraic and Differential Geometry, Australian National University, Canberra (7/10).

37. MEGA 2009: Effective methods in algebraic geometry, Barcelona (6/09)*

38. Workshop on tensors and interpolation, Nice (6/09)

39. 2009 Haifa Matrix theory Conference, U Haifa (5/09)

40. Texas geometry and topology conference, University of Houston (2/09)

41. The 28th Winter School of Geometry and Physics, Srni (1/07) - plenary lecture series.

42. Annual Conference of the Heilbronn Institute for Mathematical Research (HIMR), Bristol (9/07)

43. Workshop on Complexity, Coding, and Communication, IMA, Minneapolis MN (4/07)

44. Texas geometry and topology conference, Texas Christian University (3/07)

45. Geometry of vector distributions, differential equations, and variational problems, ITCP, Trieste (12/06)

46. Symmetries and Overdetermined Systems of Partial Differential Equations, IMA, MN. (7/06)

47. Lie algebra workshop, Field's Institute, Univ. of Ottawa (3/06)

48. Geometry Meeting in memory of Professor S.S. Chern, Guanajuato (11/05)

49. AGAFE, "Geometry of algebraic varieties" Ferrara, (6/05)

50. Seventh international conference on Geometry, Integrability and Quantization, Varna, (Course on exterior differential systems and geometry) (6/05)

51. Texas geometry and topology conference, TAMU (10/04)

52. XIV Coloquio Latinoamericano de algebra, La Falda, Argentina. Lecture and mini-course (8/01)

53. IXth Oporto meeting on Geometry, Topology and Physics, Oporto Lecture series (9/00)

Lecture series and intensive courses (since 2000)

1. Schuola Matematica Interuniversitaria summer course in Perugia (40 hours of lecture) 7/21.

2. KAIST/ICERM school and workshop on Nonlinear Algebra (4 hours of lecture) 8/20, postponed due to COVID19

3. CBMS lecture series on tensor networks, U. Auburn, (10 hours of lecture, 1 week) 7/17

4. Intensive summer course on Quantum Information Theory and Geometry (36 hours of lecture) 6-7/17

5. Summer school on Complexity Theory and Geometry for U. Vienna graduate students, Obergurgl (7.5 hours of lecture, 1 week) 9/16

6. Mini-course on algebraic geometry in complexity theory, KAIST (8 hours of lecture, 1 week) 8/15

7. Mini-course/workshop on tensors at U. Chicago, funded by IMA, (10 hours of lecture, 3 weeks) 7/14

8. An interdisciplinary approach to tensor decomposition (CIRM, Trento) (4 hours of lecture) 6/14

9. Max-Planck-Institut für Mathematik in den Naturwissenschaften, Leipzig Germany, lecture series (one week) 5/13

10. Scuola Matematica Inter-universitaria at Cortona, summer reasearch course *Tensors: Waring problems and Geometric Complexity theory* (11 hours), 7/12

11. Nordfjordeid summer school, Norway Geometry of tensors and applications (8 hours) 6/10

12. GNSAGA (3 hours), U. Firenze, 6/09

13. MSRI summer graduate workshop, (5 hours), *Geometry and Representation Theory of Tensors for Computer Science, Statistics, and other areas*, 07/08

14. UC Berkeley, Special day long seminar on representation theory and algebraic statistics 5/06

15. CIMAT, Guanajuato, *G-structures in projective geometry*, 8/06

16. Seoul National University, Seoul *Rigidity of projective varieties* 6/06

17. Korean Institute for Advanced Study (KIAS), *Billiards and exterior differential systems* 4/05

18. Scuola Matematica Inter-universitaria at Cortona, summer reasearch course *Algebraic geometry: Exceptional groups and projective geometry* (11 hours), 7/03

19. Collegio Docenti of the Ph.D. Consortium Milan-Trieste, graduate level course and research seminars (15 hours), 2/03

Other invited talks since 2000:

U. Wisc. Colloquium (9/20)
VA Tech. Geometry Seminar (9/20)
Northern Italy geometry zoom seminar (5/20)
U. Grenoble Alg. Geom. Seminar (6/19)
IPAM seminar, Warsaw (6/19)
Seminar MPI Leipzig (7/18)
U. Chicago algebraic geometry sem. (10/18)
Colloquium, UIC (2/18)
Colloquium, Cornell Univ. (10/17)
Colloquium, Stanford Univ. (3/17)
Harvard/MIT CS reading group (3/16)
Brown Algebra seminar (3/16)
Rutgers Computer Science Seminar (11/15)
SIAM algebraic geometry (3 short lectures) Daejon (8/15)
Geometry Seminar, Grenoble (6/15)
Colloquim, U. Belfort (6/15)
Harvard/MIT Algebraic Geometry Seminar (4/15)
Combinatorics, complexity of Kronecker coefficients, AIM (11/14)
U. Penn combinatorics and algebraic geometry seminar (11/14)
Computer Science/Disc. Math. at IAS (Princeton) (11/13)
New directions in EDS, Estes Park CO (7/13)
Colloquim U. Belfort (6/13)
AMS JMM session on GCT (1/13)
Computer Science/Disc. Math. at IAS (Princeton) (11/12)
Geometry seminar at Duke University (10/12)
Colloquim at UT Austin (10/12)
Geometric Methods in Rep. Theory, UNC Chapel Hill (1/12)
Algebraic geometry seminar, U. Montpellier (7/11)
Seminar, Mittag-Leffler Institute, Stockholm (5/11)
U. Chicago Statistics colloquim (2/11)
Rice U., geometry seminar (1/10)
U. Chicago Computer Science Dept. Colloquim (11/09)
Colloquim and Geometry seminar, ANU, Canberra (8/09)
UNC Chapel Hill Representation Theory Seminar (5/08)
London geometry and topology sem., Imperial College (9/07)
Harvard-MIT algebraic geometry seminar (9/07)
U. College, Cork, Ireland, colloq. and geom. seminar (9/07)
U. Bologna, geometry seminar (7/07)
UT Austin, geometry seminar (4/07)
Univ. Utah, colloquium (10/06)
SNU, Seoul, Korea, colloquium (6/06)
AMS, special session on Grobner bases, SF, CA (4/06)
Univ. of Pennsylvania, Colloquium (11/05)
Univ Texas at Austin, Geometry seminar (5/05)
TAMU, Computer Science dept. seminar (3/05)
MIT/Harvard algebraic geometry seminar (9/04)
UIUC, Colloquium (3/04)
Texas A&M, Colloquim and geometry seminar (2/04)
Rutgers University geometry seminar (11/03)
SU. Mass. Amhearst Valley geometry seminar (9/03)
U. of Georgia, Athens, Representation theory seminar (10/03)
Rutgers University, geometry seminar (11/02)
Duke University, geometry seminar (11/02)
Penn State, undergraduate colloquim (10/02)
U. of Georgia, Athens, Representation theory seminar (10/02)
Group actions, Schrodinger Inst., Vienna (10/01)
Northeastern U., rep. theory seminar (5/01)
Purdue University, colloquium (11/00)
Cornell University, Ithaca, colloquium (9/00)
U. of Debrecen, Debrecen, Hungary, colloquium (7/00)
Mathematische Institut, Basel, Algebra seminar (6/00)
CMI zoom seminar, India (6/20)
UCSD Colloquium (9/19)
Rice U. Colloquium (8/19)
Berkeley Comm. Alg. seminar (double lect.) (1/19)
Warsaw geometry seminar (11/18)
U. Missouri algebraic geometry sem. (10/18)
Comp. and Appl. Math. Colloq., U. Chicago (2/18)
Colloquium, Syracuse Univ. (4/17)
Rocky Mtn. Alg. Comb. Seminar, Colorado State (10/16)
Algebraic Geometry Seminar U. Chicago (5/16)
UVA colloquim (10/15)
Princeton Computer Science Seminar (11/15)
Rep. theory seminar U. Basel (6/15)
Seminar U. Lyon (6/15)
Rutgers Computer Science Seminar (4/15)
MIT Algorithms and Complexity Seminar (4/15)
Rutgers geometry seminar (11/14)
Eisenbud seminar, UC Berkeley (12/14)
Geometry seminar at Rutgers Univ. (11/13)
GCT workshop, Brno (8/13)
U. Chicago Alg. Geom. Seminar (2/13)
Geometry seminar at Rutgers Univ. (11/12)
Symbolic Computation Seminar at NC State (10/12)
Geometry/rep. theory seminar at UNC Chapel Hill (10/12)
Rep. Theory, Combinatorics, and Geom., UC Berkeley (5/12)
Algebraic geometry seminar, Princeton U. (11/11)
Colloquium, Linkoping U., Linkoping Sweden. (6/11)
TAGS (graduate student talk), Rice U., Houston (4/11)
UIC colloquim (3/10)
WUSTL, St. Louis, Colloquim (12/09)
U. Grenoble Geometry seminar (11/09)
UC Irvine Geometry seminar, (6/08)
Exterior Differential Systems Workshop, MSRI (5/08)
Geometry day at Loughborough (9/07)
Northeastern geometry-represenation theory seminar (9/07)
U. Firenze, geometry seminar (7/07)
U. Grenoble, geometry seminar (7/07)
Duke University, geometry seminar (10/06)
KIAS, Seoul, Korea, geometry seminar (6/06)
SIAM, mini-symposium on billiards and EDS, Boston (7/06)
Univ. of Houston, Colloquium (1/06)
Rice Univ., Colloquium (9/05)
UIUC, geometry seminar (3/05)
TAMU, Math-physics Harmonic analysis seminar (3/05)
Univ. Fourier, Grenoble, Algebraic geometry seminar, (5/04)
Georgia Southern colloquium (2/04)
AIM workshop in computational algebraic statistics (12/03)
Emory University colloquim (10/03)
Harvard/MIT algebraic geometry seminar (9/03)
Southeast geometry conference, College of Charleston (3/03)
UNC, Chapel Hill, algebraic geometry seminar (11/02)
Penn State, Colloquium (10/02)
University of Warwick, Algebra seminar (10/02)
University of Utah, colloquium (4/02)
Northeastern U., colloquium (5/01)
U. of Georgia, Athens, colloquium (2/01)
Purdue University, geometry seminar (11/00)
Cornell University, Ithaca, Lie theory seminar (9/00)
Basel/Freibourg/Strasbourg Lie theory seminar (6/00)
Jussieu, Paris, journeé de la géometrie algebrique (6/00)