

Joseph M. Landsberg
Dept. of Mathematics
Texas A&M University
Mailstop 3368
College Station, TX 77843-3368
<http://www.math.tamu.edu/~jml>
email: jml@math.tamu.edu

Employment:

Texas A&M University, College Station, TX, professor of mathematics (8/04- present).
Chancellor's Professor at Simons Institute for Theoretical Computing/University of California at Berkeley, Berkeley, CA, (8/14-12/14).
Harvard University, invited visiting professor (7/04-12/04).
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).

Awards and Fellowships: AMS fellow (class of 2017), UC Berkeley fall 2014 Chancellor's Professor, 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 différentielle 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)

Institute 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.

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 (since fall 2017 inception).

Supervision.

Postdoctoral supervision:

A. Harper (8/18-present)

E. Ventura (8/17-present)

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

C. Ikenmeyer (1/13-5/16), currently at Max Plank Institut, Saarbrüchen

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

A. Boralevi (8/08-7/10), currently assistant 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 at Boise State U.

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

J. Dilles (8/06-12/07), currently at Georgia Southern Univ.

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

PhD students:

1. F. Gesmundo, *Geometry and representation theory in the study of matrix rigidity*, PhD 7/17, currently research post-doctoral fellow at U. Copenhagen.
2. C. Farnsworth, *The polynomial Waring problem and the determinant*, PhD 8/16, currently research post-doctoral fellow at Yonsei University, Seoul.
3. 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.
4. C. Porter, *The local equivalence problem for 7-dimensional, 2-nondegenerate CR manifolds whose cubic form is of conformal unitary type*, PhD 8/16, currently a post-doctoral fellow at North Carolina State University.
5. Y. Qi, *Geometry of Feasible Spaces of Tensors*. PhD 8/13. Currently joint U. Grenoble (engineering) U. Chicago (statistics) postdoctoral fellow.
6. M. Yang, *On partial and generic uniqueness of block term tensor decompositions in signal processing*. PhD 12/12. Currently at Southern Il. U. Carbondale.
7. 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.
8. L. Oeding, *Defining equations of the variety of principal minors*. PhD 5/09. NSF post-doctoral fellow at Firenze followed by RTG postdoctoral fellow at UC Berkeley, currently tenure track at Auburn Univ.
9. F. Holweck, *Singularities of hyperplane sections of homogenous varieties*. PhD 9/04 from Université Toulouse III. Currently MDC (associate professor) at U. Belfort.

10. 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, A. Conner, A. Pal.

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: Supervised project of D. Allums, resulting in the publication of "Border rank of ternary trilinear forms and the j-invariant", *Involve* **8** (2015), no. 2, 345-355. P. Sarin, resulting in the preprint (submitted) "On the geometry of Tensor Network States of 2xN Grids", arXiv:1806.03567.

Service since 2006

TAMU math dept. subcommittee P (9/18-current)

TAMU math dept. Undergraduate committee (9/17-current)

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 *special session on applications of algebraic geometry and representation theory* at 2017 Spring Southeast AMS sectional meeting, Vanderbilt University (4/18)
2. Co-organizer of *Working Group on Representation Theory and GCT*, Santa Fe Institute (12/16)
3. Co-organizer of the *fall 2016 Texas geometry and topology conference (TGTC)*, TAMU (11/16)
4. Co-organizer of *Differential Geometry and its Applications conference*, and Organizer of a *special workshop on the complexity of matrix multiplication*, Brno (8/16)

5. Co-organizer of the *Algorithms and Complexity in Algebraic Geometry reunion workshop*, Simons Institute of Theoretical Computing, Berkeley (12/15)
6. Steering committee for *SIAM Algebraic Geometry activity group conference and special session organizer*, Daejeon (8/15)
7. Co-organizer of *Special semester on Algorithms and Complexity in Algebraic Geometry*, Simons Institute of Theoretical Computing, Berkeley CA (fall 2014)
8. Co-organizer of *Workshop on uses of algebraic geometry in combinatorial and computational geometry*, IPAM, Los Angeles, CA (4/14)
9. Co-organizer of *Differential Geometry and its Applications conference*, and organizer of a *special session on Geometric Complexity Theory*, Brno (8/13)
10. 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)
11. Co-organizer of *Questions in geometry arising in the sciences* TAMU (4/12)
12. Co-organizer of *Mathematical aspects of P v. NP and variants*, ICERM, Brown University, Providence, RI, (8/11)
13. Steering committee for: *Latin American School on Algebraic Geometry and Applications /Escuela Latinoamericana de Geometra Algebraica y Aplicaciones (ELGA 2011)* (8/11)
14. Co-organizer of the *fall 2010 Texas geometry and topology conference (TGTC)*, TAMU (11/10)
15. Steering committee for: *Tensor Decompositions and Applications (TDA 2010)* Bari (Engineering conference on tensors) (09/10)
16. Co-organizer of the *spring 2009 Texas Algebraic Geometry Seminar*, TAMU (05/09)
17. Co-organizer and teacher of MSRI summer graduate workshop, *Geometry and Representation Theory of Tensors for Computer Science, Statistics, and other areas*, (07/08)
18. Co-organizer of AIM workshop *Geometry and representation theory of tensors for computer science, statistics and other areas* (07/08)
19. Co-organizer of the *fall 2007 Texas geometry and topology festival*, TAMU (11/07)

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*

http://www.math.tamu.edu/seminars/studentpd_geom_work/

Editorial board membership

FOCM since 2015

Differential geometry and its applications since 2010

Linear algebra and its applications since 2012

special issue of SIGMA, Eli Cartan and differential geometry (2008)

Membership

Member of the AMS and SIAM.

Publications

Research articles

1. “Matrix Product States and the Quantum Max-Flow/Min-Cut Conjectures” (with F. Gesmundo and M. Walter),
to appear in *J. Mathematical Physics*.
2. “Explicit polynomial sequences with maximal spaces of partial derivatives and a question of K. Mulmuley”, (with F. Gesmundo), arXiv:1705.03866,
to appear in *Theory of Computing*.
3. “The geometry of rank decompositions of matrix multiplication II: 3x3 matrices”, (with G. Ballard, C. Ikenmeyer, and N. Ryder), arXiv:1801.00843,
to appear in *JPAA*.
4. “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
5. “Polynomials and the exponent of matrix multiplication”, (with L. Chiantini, J. Hauenstein, C. Ikenmeyer, and G. Ottaviani),
to appear in *BLMS*, arXiv:1706.05074.
6. “The geometry of rank decompositions of matrix multiplication I: 2x2 matrices”, (with L. Chiantini, C. Ikenmeyer, and G. Ottaviani),
to appear in *Exper. Math.* arXiv:1610.08364
7. “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.
8. “On the complexity of the permanent in various computational models”, (with C. Ikenmeyer),
J. Pure Appl. Algebra **221** (2017), no. 12, 2911–2927.

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, 20372045
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. “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.
12. “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.
13. “Abelian Tensors”, (with M. Michalek),
J. Math. Pures Appl. (9) **108** (2017), no. 3, 333–371.
14. “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.
15. “Complexity of linear circuits and geometry ”, (with F. Gesmundo, J. Hauenstein, and C. Ikenmeyer)
FOCM **16**(2016) no. 3, 599–635.
16. “New lower bounds for the border rank of matrix multiplication”, (with G. Ottaviani)
Theory of Computing, **11** (2015), 285–298.
17. “Explicit tensors of border rank at least $2n - 1$ ”,
J. Pure and appl. Algebra, **219** (2015), no. 8, 3677-3684.
18. “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.
19. “Geometric Complexity Theory: an introduction for geometers”,
Annali di Matematica dell’Universit di Ferrara, **61** (2015), no. 1, 65-117.
20. “New lower bounds for the rank of matrix multiplication”,
SIAM J. Comput. **43** (2014), no. 1, 144-149.
21. “Padded polynomials, their cousins, and geometric complexity theory”, (with H. Kadish),
Comm. Algebra **42** (2014), no. 5, 2171-2180.

22. “On the third secant variety” (with J. Buczynski),
J. Algebraic Combin. **40** (2014), no. 2, 475-502.
23. “Equations for lower bounds on the border rank” (with G. Hauenstein and C. Ikenmeyer),
Exp. Math. **22** (2013), no. 4, 372-383.
24. “Determinantal 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.
25. “Equations for secant varieties of Veronese and other varieties” (with G. Ottaviani),
Ann. Mat. Pura Appl. (4) **192** (2013), no. 4, 569-606.
26. “Fubini-Griffiths-Harris rigidity of homogeneous varieties” (with C. Robles),
Int. Math. Res. Not. IMRN **7** (2013), 1643-1664.
27. “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.
28. “Holographic algorithms without matchgates” (with J. Morton and S. Norine),
Linear Algebra Appl. **438** (2013), no. 2, 782–795.
29. “Ranks of tensors and a generalization of secant varieties” (with J. Buczynski),
Linear Algebra Appl. **438** (2013), no. 2, 668–689.
30. “On the geometry of Tensor Network States” (with Y. Qi and K. Ye),
Quantum Inf. Comput. **12** (2012), no. 3-4, 346–354.
31. “Fubini-Griffiths-Harris rigidity and Lie algebra cohomology” (with C. Robles),
Asian J. Math. **16** (2012), no. 4, 561-586.
32. “An overview of mathematical issues arising in the Geometric complexity theory approach
to $VP \neq VNP$ ” (with P. Bürgisser, L. Manivel and J. Weyman),
SIAM J. Comput. **40** (2011), no. 4, 1179–1209.
33. “Lines on hypersurfaces” (with C. Robles),
J. London Math. Soc. (2) **82** (2010), no. 3, 733–746,
34. “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.
35. “P versus NP and geometry”
J. Symbolic Computation, **45** (2010) 1359-1377.

36. “On the ranks and border ranks of symmetric tensors” (with Z. Teitler),
Found. Comput. Math. **10** (2010), no. 3, 339366.
37. “On secant varieties of Compact Hermitian Symmetric Spaces” (with J. Weyman),
Journal of Pure and Applied Algebra **213** (2009), no. 11, 2075–2086.
38. “Fubini’s Theorem in codimension two” (with C. Robles),
J. Reine Angew. Math. **631** (2009), 221–235.
39. “Geometry and the complexity of matrix multiplication”,
Bull. Amer. Math. Soc. (N.S.) **45** (2008), no. 2, 247–284.
40. “Differential geometry of submanifolds of projective space”
in *Symmetries and overdetermined systems of partial differential equations*, 105–125, IMA
Vol. Math. Appl., **144** (2008)
41. “Generalizations of Strassen’s equations for secant varieties of Segre varieties ” (with L.
Manivel),
Comm. Algebra **36** (2008), no. 2, 405–422
42. “On the ideals and singularities of secant varieties of Segre varieties” (with J. Weyman),
Bull. Lond. Math. Soc. **39** (2007), no. 4, 685–697.
43. “Legendrian varieties” (with L. Manivel),
Asian J. Math. **11** (2007), no. 3, 341–359
44. “On Tangential varieties of rational homogeneous varieties” (with J. Weyman),
Journal Lond. Math. Soc. **76** (2007) (2), 513–530.
45. “The border rank of the multiplication of two by two matrices is seven”
J. Amer. Math. Soc. **19** (2006), no. 2, 447–459
46. “A universal dimension formula for complex simple Lie algebras” (with L. Manivel),
Adv. Math. **201** (2006), no. 2, 379–407.
47. “The sextonions and $E_{7\frac{1}{2}}$ ” (with L. Manivel),
Adv. Math. **201** (2006), no. 1, 143–179.
48. “Griffiths-Harris rigidity of compact Hermitian symmetric spaces”
J. Differential Geometry **74** (2006) 395–405.
49. “On the ideals of secant varieties of Segre varieties” (with L. Manivel),
Found. Comput. Math. **4** (2004), no. 4, 397–422.

50. “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.
51. “Series of Lie Groups” (with L. Manivel),
Michigan Math. J. **52** (2004), no. 2, 453–479
52. “Series of nilpotent orbits” (with L. Manivel and B. Westbury),
Experiment. Math. **13** (2004), no. 1, 13–29.
53. “Lines on algebraic varieties”
Journal für die reine und angewandte Mathematik (Crelle), **562** (2003) 1–3.
54. “On the projective geometry of homogeneous varieties” (with L. Manivel),
Commentari Math. Helv., **78**(2003) 65–100.
55. “Triality, exceptional Lie algebras, and Deligne dimension formulas”(with L. Manivel) ,
Advances in Mathematics **171** (2002) 59–85.
56. “Construction and classification of complex simple Lie algebras via projective geometry”
(with L. Manivel),
Selecta Mathematica, **8** 137–159 (2002).
57. “On the projective geometry of Freudenthal’s magic chart” (with L. Manivel),
J. Algebra, **239** 477–512 (2001).
58. “On the infinitesimal rigidity of homogeneous varieties”,
Compositio Mathematica, **118** (1999) 189–201.
59. “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.
60. “On symmetric degeneracy loci, spaces of symmetric matrices of constant rank and dual varieties ” (with B. Ilic),
Mathematische Annalen, **314** (1999) 159–174.
61. “On a conjecture of Kontsevich and variants of Castelnuovo’s lemma”,
Compositio Mathematica **115** (1999) 231–239 and **140** (2004), no. 4, 1112..
62. “On minimal isometric embeddings” (with T. Ivey),
Duke Mathematical Journal **89**(1997) 555–576.
63. “Differential-geometric characterizations of complete intersections”,
Journal of Differential Geometry **44** (1996) 32–73.

64. “On degenerate secant and tangential varieties and local differential geometry”,
Duke Mathematical Journal **85**(1996) 605–634.
65. “On second fundamental forms of projective varieties”,
Inventiones Math. **117**(1994) 303–315.
66. “Minimal submanifolds defined by first order systems of PDE”,
Journal of Differential Geometry, **36**(1992) 369–417.
67. “Minimal submanifolds of E^{2n+1} arising from degenerate $SO(3)$ orbits on the Grassmanian”,
AMS Transactions, **325**(1991), 101–117.

Submitted research articles

1. “Stable recovery of the factors from a deep matrix product and application to convolutional network”, (with F. Malgouyres) arXiv:1703.08044

Expository articles

1. “On the geometry of matrix multiplication”. Notices Amer. Math. Soc. **65** (2018), no. 4, 402 (invited article)
2. “A very brief introduction to quantum computing and quantum information theory for mathematicians” (invited article), to appear in *Quantum Physics and Geometry*, UMI Springer Lecture Notes.
3. “An introduction to geometric complexity theory” (invited article),
Eur. Math. Soc. Newsl. **99** (2016), 10–18.
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, 2935, ACM, New York, 2016
5. “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.
6. “Exterior differential systems and billiards”,
Geometry, Integrability and Quantization VII edited by Ivailo M. Mladenov and Allen C. Hirshfeld. 35–54, Softex, Sofia, 2006.
7. “Representation theory and projective geometry” (with L. Manivel),
Algebraic transformation groups and algebraic varieties, 71–122, Encyclopaedia Math. Sci., 132, Springer, Berlin, 2004

8. “ G -structures via three examples”,
Web theory and related topics, Grifone, Salem, eds., World Scientific 2001, 133–150.
9. “Exterior differential systems: a geometric approach to pde”,
Proc. Workshop pure math. **17.III**(1998) pp. 77-101.
10. “Géométrie algébrique et géométrie différentielle projective”,
Prépublication 106 du Laboratoire E. Picard, décembre 1997. (Habilitation à diriger des recherches)
11. “On the local differential geometry of complete intersections”
Séminaire de théorie spectrale et géométrie, Grenoble (1994-1995) pp. 1-12.

Books

1. “Tensors: An Introduction, Developments 2016–2018, and Asymptotic Geometry” *CBMS lecture series*, AMS, to appear Jan. 2019.
2. “Geometry and Complexity Theory”,
Cambridge Studies in Advanced Mathematics 169, Cambridge Univ. Press. 2017.
3. “Tensors: Geometry and Applications”
AMS graduate studies in mathematics vol 128, 2011. 439 pages.
4. “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.
5. “Algebraic geometry and projective differential geometry, Seoul National University concentrated lecture series 1997”
Seoul National University Press (1999). 85 pages.

Research invitations

- 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)
 Mathematische 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)

1. Tensors: geometry and quantum information, Copenhagen (7/18)
2. Southeastern Section AMS, Vanderbilt University (4/18)
3. SLAM, U. Arkansas (2/18)
4. Berlin-Leipzig Seminar on Algebra, Geometry and Combinatorics (10/17)
5. SIAM Algebraic Geometry meeting, Georgia Tech, Atlanta (7/17)
6. Quantum Physics and Geometry, Levico Terme (7/17)
7. ALGECOM, Purdue University (10/16)
8. CMO Workshop: Integrability and Near-Integrability in Mechanics and Geometry, Oxaca (6/16)
9. The Classification Program of Counting Complexity workshop, Simons Inst. UC Berkeley (3/16)
10. Innovations in Theoretical Computer Science MIT, (1/15) [not a plenary talk but a competitive CS conference]
11. Simons Algebraic Geometry reunion workshop (12/15)
12. Wildness in Computer Science, Physics and Mathematics, Santa Fe Institute (10/15)
13. Optimization in machine learning, vision and image processing, CIMI Toulouse, (10/15)
14. GCT Workshop, ENS Lyon, (6/15)
15. Workshop: Tensor Low-rank Optimization and Applications, Bonn, (6/15)
16. ICRTCA conference in honor of J. Weyman, U. Conn (4/15)
17. Berlin Mathematical School Colloquium , Berlin (2/15)

18. Tensor workshop, Simons Inst. UC Berkeley (11/14)
19. Geometric Complexity Theory Workshop, Simons Inst. UC Berkeley (9/14)
20. ICERM workshop on computational multilinear algebra, Providence, RI (6/14)
21. Tools from Algebraic Geometry at IPAM, UCLA (4/14)
22. Computational Algebraic Statistics, Theories and Applications (CASTA 2014), Kyoto (1/14)
23. Quantum Marginals conference, Isaac Newton Institute for Mathematical Sciences, Cambridge UK (10/13)
24. Tensor network algorithms in computational physics and numerical analysis, ETH Zurich (5/13)
25. The interaction of geometry and representation theory: exploring new frontiers (conference in honor of 60th birthday of M. Eastwood) at ESI (Vienna) (9/12)
26. Genova-Torino-Milano seminar, Torino (6/12)
27. 17-th Conference of the International Linear Algebra Society, Braunschweig (8/11)
28. Conformal Differential Geometry and its Interaction with Representation Theory, University of Arkansas, Fayetteville (4/11)
29. Workshop on Tensor Decompositions and Applications (TDA), Bari (9/10).
30. Differential Geometry and its Applications (DGA2010), Brno, (8/10).
31. Mathematics and Physics on the Borderline between Algebraic and Differential Geometry, Australian National University, Canberra (7/10).
32. MEGA 2009: Effective methods in algebraic geometry, Barcelona (6/09)
33. Workshop on tensors and interpolation, Nice (6/09)
34. 2009 Haifa Matrix theory Conference, U Haifa (5/09)
35. Texas geometry and topology conference, University of Houston (2/09)
36. The 28th Winter School of Geometry and Physics, Srni (1/07) - plenary lecture series.
37. Annual Conference of the Heilbronn Institute for Mathematical Research (HIMR), Bristol (9/07)
38. Workshop on Complexity, Coding, and Communication, IMA, Minneapolis MN (4/07)
39. Texas geometry and topology conference, Texas Christian University (3/07)
40. Geometry of vector distributions, differential equations, and variational problems, ITCP, Trieste (12/06)

41. Symmetries and Overdetermined Systems of Partial Differential Equations, IMA, MN. (7/06)
42. Lie algebra workshop, Field's Institute, Univ. of Ottawa (3/06)
43. Geometry Meeting in memory of Professor S.S. Chern, Guanajuato (11/05)
44. AGAFE, "Geometry of algebraic varieties" Ferrara, (6/05)
45. Seventh international conference on Geometry, Integrability and Quantization, Varna, (Course on exterior differential systems and geometry) (6/05)
46. Texas geometry and topology conference, TAMU (10/04)
47. XIV Coloquio Latinoamericano de algebra, La Falda, Argentina. Lecture and mini-course (8/01)
48. IXth Oporto meeting on Geometry, Topology and Physics, Oporto Lecture series (9/00)

Lecture series and intensive courses (since 2000)

1. CBMS lecture series on tensor networks, U. Auburn, (10 hours of lecture, 1 week) 7/17
2. Intensive summer course on Quantum Information Theory and Geometry (36 hours of lecture) 6-7/17
3. Summer school on Complexity Theory and Geometry for U. Vienna graduate students, Obergurgl (7.5 hours of lecture, 1 week) 9/16
4. Mini-course on algebraic geometry in complexity theory, KAIST (8 hours of lecture, 1 week) 8/15
5. Mini-course/workshop on tensors at U. Chicago, funded by IMA, (10 hours of lecture, 3 weeks) 7/14
6. An interdisciplinary approach to tensor decomposition (CIRM, Trento) (4 hours of lecture) 6/14
7. Max-Planck-Institut für Mathematik in den Naturwissenschaften, Leipzig Germany, lecture series (one week) 5/13
8. Scuola Matematica Inter-universitaria at Cortona, summer reasearch course *Tensors: Warning problems and Geometric Complexity theory* (11 hours), 7/12
9. Nordfjordeid summer school, Norway Geometry of tensors and applications (8 hours) 6/10
10. GNSAGA (3 hours), U. Firenze, 6/09
11. MSRI summer graduate workshop, (5 hours), *Geometry and Representation Theory of Tensors for Computer Science, Statistics, and other areas*, 07/08

12. UC Berkeley, Special day long seminar on representation theory and algebraic statistics 5/06
13. CIMAT, Guanajuato, *G-structures in projective geometry*, 8/06
14. Seoul National University, Seoul *Rigidity of projective varieties* 6/06
15. Korean Institute for Advanced Study (KIAS), *Billiards and exterior differential systems* 4/05
16. Scuola Matematica Inter-universitaria at Cortona, summer reasearch course *Algebraic geometry: Exceptional groups and projective geometry* (11 hours), 7/03
17. Collegio Docenti of the Ph.D. Consortium Milan-Trieste, graduate level course and research seminars (15 hours), 2/03

Other invited talks since 2000:

- 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)
Colloquium, 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)
Colloquium 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)
Colloquium 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 colloquium (2/11)
Rice U., geometry seminar (1/10)
U. Chicago Computer Science Dept. Colloquium (11/09)
Colloquium 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, Colloquium and geometry seminar (2/04)
Rutgers University geometry seminar (11/03)
SU. Mass. Amherst 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 colloquium (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)
Oct. 25-6 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 colloquium (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 colloquium (3/10)
WUSTL, St. Louis, Colloquium (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-representation 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 colloquium (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, journée de la géométrie algébrique (6/00)