

FULVIO GESMUNDO

QMATH - Department of Mathematics
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Personal Information

born in Florence (Italy), on January 20th, 1987
Italian Citizenship

Education

- 2013 – 2017 **Ph.D. in Mathematics at Texas A&M University.**
Advisor: Prof. J.M. Landsberg
Graduation: May 2017
Thesis: Geometry and Representation Theory in the Study of Matrix Rigidity
- 2010 – 2012 **M.S. in Mathematics at Università degli Studi di Firenze (University of Florence).**
Advisor: Prof. Giorgio Ottaviani.
Graduation: April 2012.
Thesis : Rango di tensori e Varietà Secanti
(Tensor Rank and Secant Varieties)
- 2006 – 2010 **B.S. in Mathematics at Università degli Studi di Firenze (University of Florence).**
Advisor: Prof. Donato Pertici.
Graduation: April 2010.
Thesis: Spazi Completamente Regolari e Compattificazione di Stone-Čech
(Completely Regular Spaces and Stone-Čech Compactification)

Awards

- May 2017 *L.F. Guseman Prize* - May 1st, 2017 - College Station, TX
- May 2016 *Bush School Travel Grant* - May 20th, 2016 - College Station, TX
- March 2013 *Premio di Laurea Luigi Campedelli (Luigi Campedelli Thesis Prize)* for my Master's Thesis -
March 11th, 2013 - Florence, Italy

Work experience

- 2020 – **PostDoc**
Max Planck Institute for Mathematics in the Sciences, Leipzig. Nonlinear Algebra Group.
- 2017 – 2020 **PostDoc**
University of Copenhagen. QMATH – Department of Mathematical Sciences.
- Fall 2018 **Visiting Scholar**
Institute for Computational and Experimental Research in Mathematics. Providence, RI.
during a semester-long program on *Nonlinear Algebra*
- Fall 2014 **Visiting Scholar**
Simons Institute for the Theory of Computing. U.C. Berkeley.
during a semester-long program on *Algorithms and Complexity in Algebraic Geometry*
- 2013 – 2017 **Graduate Student**
Texas A&M University. Department of Mathematics.

Organization

June 2018 **QMath Masterclass - Tensors: Geometry and Quantum Information**
University of Copenhagen and Niels Bohr International Academy.
Invited speakers: P. Bürgisser, J.M. Landsberg, G. Ottaviani, P. Vrana and M. Walter.
<https://indico.nbi.ku.dk/event/1088/>
Co-organizers: S. Andersen, M. Christandl, A. H. Werner.

Teaching experience

2017 – 2019 **PostDoc**
University of Copenhagen. Department of Mathematics.
Teaching assistant for Complex Analysis II, Spring 2019 and Fall 2019

2013 – 2017 **Teaching Assistant**
Texas A&M University. Department of Mathematics.
Teaching assistant experience in several topics in Mathematics:
Help Sessions in Linear Algebra (Spring 2013)
Recitations in Calculus 1 (Fall 2013)
Help Sessions in Linear Algebra (Spring 2014)
Grader for History of Math (Fall 2014)
Recitations in Calculus 2 (Spring 2015)
Grader for Cryptography (Spring 2016 - Fall 2016)

Outreach

2017 **Kulturnatten**
University of Copenhagen.
Collaboration in the event organized by QMATH on *cake cutting with straight edge and compass*.

2015 **Pi Day of the Century**
Texas A&M University.
Outreach event geared towards elementary, middle and high school students,
in collaboration with Texas A&M Math Circle.

2008 – 2012 **Gara matematica (Mathematics Contest)**
Dipartimento di Matematica Ulisse Dini, Florence.
Collaboration in proctoring and grading in an annual contest for high school students.

Computer skills

Programming bash, HTML. Basics of C, Python

Math Advanced knowledge: Macaulay2, MatLab (octave), LiE, bertini.

Software Intermediate knowledge: Maple, Mathematica, Schur.

Publications

- 1 **SARS-CoV-2 transmission routes from genetic data: a Danish case study.** (w/A. Bluhm, M. Christandl, F. R. Klausen, L. Mancinska, V. Steffan, D. Stilck França, A. Werner)
PLOS ONE 15 (10), e0241405, doi:10.1371/journal.pone.0241405.
- 2 **Border rank non-additivity for higher order tensors.** (w/M. Christandl, M. Michałek, J. Zuiddam)
arXiv:2007.05458.
- 3 **Optimization at the boundary of the tensor network variety.** (w/M. Christandl, D. Stilck França, A. Werner)
arXiv:2006.16963.
- 4 **Geometric conditions for strict submultiplicativity of rank and border rank.** (w/E. Ballico, A. Bernardi, E. Ventura, A. Oneto)
Ann. Mat. Pura ed Appl. (2020), doi:10.1007/s10231-020-00991-6.

- 5 **Towards a Geometric Approach to Strassen's Asymptotic Rank Conjecture.** (with A. Conner, J. M. Landsberg, E. Ventura, Y. Wang)
Collectanea Math., (2020), doi:10.1007/s13348-020-00280-8.
- 6 **Kronecker powers of tensors and Strassen's laser method.** (w/A. Conner, J. M. Landsberg, E. Ventura)
ITCS 2020, Leibniz International Proceedings in Informatics (LIPIcs), 151, 10:1–10:28 (2020), doi:10.4230/LIPIcs.ITCS.2020.10.
- 7 **Partially symmetric versions of Comon's problem via simultaneous rank.** (w/A. Oneto, E. Ventura)
SIAM J. Matrix Anal. Appl., 40(4), 1453–1477 (2019), doi:10.1137/18M1225422.
- 8 **The Degree of Stiefel Manifolds.** (w/T. Brysiewicz)
preprint arXiv:1909.10085, 2019.
- 9 **Tensors with maximal symmetries.** (w/A. Conner, J. M. Landsberg, E. Ventura)
preprint arXiv:1909.09518, 2019.
- 10 **Explicit polynomial sequences with maximal spaces of partial derivatives and a question of K. Mulmuley.** (w/J.M. Landsberg)
Theory of Computing 15(3), 1–24, (2019), doi:10.4086/toc.2019.v015a003.
- 11 **Border Waring Rank via Asymptotic Rank.** (w/M. Christandl, A. Oneto)
preprint arXiv:1907.03487, 2019.
- 12 **Border rank is not multiplicative under the tensor product.** (w/M. Christandl, A. K. Jensen)
SIAM J. Appl. Alg. Geom (SIAGA), Vol. 3 (2), 231–255 (2019), doi:10.1137/18M1174829.
- 13 **On the partially symmetric rank of tensor product of W -states and other symmetric tensors.** (w/E. Ballico, A. Bernardi, M. Christandl)
Rend. Lincei Mat. Appl. 30, 93–124 (2019), doi:10.4171/RLM/837.
- 14 **A note on the cactus rank for Segre-Veronese varieties.** (w/E. Ballico, A. Bernardi)
J. Algebra Vol. 526, pp. 6-11 (2019), doi:10.1016/j.jalgebra.2019.01.027.
- 15 **Matrix Product States and the Quantum max-flow/min-cut conjectures.** (w/J. M. Landsberg, M. Walter)
J. Math. Phys, Vol. 59 (10), 102205 (2018), doi:10.1063/1.5026985.
- 16 **Geometric Complexity Theory and matrix powering.** (w/C. Ikenmeyer, G. Panova)
Diff. Geom. and Appl., Vol. 55, 106–127 (2017), doi:10.1016/j.difgeo.2017.07.001.
- 17 **Geometric Aspects of Iterated Matrix Multiplication**
J. Algebra Vol. 461, pp.42–64, (2016), doi:10.1016/j.jalgebra.2016.04.028.
- 18 **Complexity of linear circuits and geometry.** (w/J. Hauenstein, C. Ikenmeyer, J. M. Landsberg)
FOCM, Vol. 16 (3), 599–635, (2016), doi:10.1007/s10208-015-9258-8.
- 19 **An asymptotic bound for secant varieties of Segre varieties**
Ann. Univ. Ferrara, Vol.59 (2), 285-302, (2013), doi:10.1007/s11565-013-0175-y.

Selected seminars and Posters

Invited talks:

- Nov. 2020 **Segre reembedding of secant varieties and multiplicativity of rank and border rank**
Real Algebraic Geometry Seminar. University of Konstanz.
- Oct. 2020 **Approaching the boundary of tensor network varieties**
Geometry Seminar. Texas A&M University - College Station, TX.
- March 2020 **Border rank and tensor product: geometry and complexity**
Nonlinear Algebra Seminar Online. Organized by Max Planck Institute - Leipzig.
- Sept. 2019 **Tensors, Symmetries and Matrix Multiplication**
Congresso UMI 2019. Università di Pavia - Italy.
- Jul. 2019 **Rank, border rank, multiplicativity and entanglement**
SIAM Conference Applied Algebraic Geometry (SIAM AG19). University of Bern - Switzerland.

- Jan. 2019 **Tensors with Symmetries and Matrix Multiplication**
Workshop on Theoretical Computer Science and Algebraic Geometry. Max Planck Institute for Informatics
 - Saarbrücken - Germany.
- Nov. 2018 **Rank of Forms and Partial Derivatives**
Geometry Seminar. Texas A&M University - College Station, TX.
- Sept. 2018 **Barriers for Geometric Methods in Complexity Theory**
UMI-SIMAI-PTM Joint Meeting. Wrocław - Poland.
- Tensors with Symmetries and Matrix Multiplication**
Workshop: Tensors. Politecnico di Torino - Turin.
- July 2018 **SLOCC transformations, tensor restriction and Strassen's asymptotic rank conjecture**
Quantum Information, Geometry and Algebra Seminar. Università degli Studi di Trento.
- April 2018 **Cactus rank and multihomogeneous polynomials**
Geometry Seminar. Texas A&M University - College Station, TX.
- Feb. 2018 **Multiplicativity of rank and border rank**
Seminario di Geometria. Dipartimento di Matematica e Informatica Ulisse Dini - Firenze.
- Sept. 2017 **On multiplicativity of various notions of rank**
Geometry seminar. Texas A&M University - College Station, TX.
- Jan. 2017 **Rigidità di matrici e complessità del prodotto matrice-vettore**
Seminario di Geometria. Dipartimento di Matematica e Informatica Ulisse Dini - Firenze.
- Geometric Complexity Theory and matrix powering.** TU Berlin.
- Geometry and complexity of matrix-vector multiplication**
Workshop on Non-linear Algebra. Max Planck Institute for Mathematics in the Sciences - Leipzig.
- July 2016 **Matrix Rigidity and the Complexity of Performing a Linear Map**
DGA: Differential Geometry and Applications Conference. Masaryk University - Brno.
- May 2016 **Geometry of Small Matrix Multiplication**
Workshop on Software and Applications in Numerical A.G.. University of Notre Dame.
- Nov. 2014 **The Geometry of Iterated Matrix Multiplication**
Computational Algebraic Geometry Seminar. UC Berkeley.

Local talks and posters:

- Nov. 2019 **Varieties of Sums of Powers, Stiefel manifolds and their degrees**
Quantum Lunch Seminar. University of Copenhagen.
- Mar. 2019 **Waring rank, apolarity and partial derivatives**
Quantum Lunch Seminar. University of Copenhagen.
- Nov. 2017 **On the interplay between Algebraic Geometry and Complexity Theory**
Quantum Lunch Seminar. University of Copenhagen.
- Apr. 2017 **Polynomials with maximal catalecticant rank and consequences in complexity theory**
Geometry Seminar. Texas A&M University.
- Apr. 2017 **Algebra, geometry and complexity: How hard is it to compute a polynomial?**
GSO Seminar. Texas A&M University.
- Nov. 2015 **Introduction to Apolarity: How to solve a cubic equation using linear algebra**
GSO Seminar. Texas A&M University.
- April 2014 **Poster: Complexity of matrix-vector multiplication and matrix rigidity**
TAGS: Texas Algebraic Geometry Symposium. Rice University.
- Jan. 2014 **Complexity of matrix-vector multiplication and matrix rigidity**
Algebraic Geometry Seminar. Texas A&M University.
- Sept. 2013 **On the border rank of Iterated Matrix Multiplication**
Graduate Students and PostDocs Working Geometry Seminar. Texas A&M University.
- March 2012 **Rango di Tensori e Varietà Secanti**
Seminario di Tesi. Dipartimento di Matematica Ulisse Dini - Firenze.

Last update: November 21, 2020.