

FULVIO GESMUNDO

QMATH - Department of Mathematics
Universitetsparken 5
2100 Copenhagen Ø, Denmark
✉ fulges@math.ku.dk

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

- 2017 – **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)
Recitation 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:

- 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.