

# FULVIO GESMUNDO

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## Personal Information

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

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## 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)

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## 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

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## Work experience

- 2022 – **PostDoc**  
*University of Saarland, Saarbrücken.* Dept. of Mathematics and Computer Science.
- 2020 – 2022 **PostDoc**  
*Max Planck Institute for Mathematics in the Sciences, Leipzig.* Nonlinear Algebra Group.
- 2017 – 2020 **PostDoc**  
*University of Copenhagen.* QMATH – Dept. 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.

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## Organization

- June 2021 - **Nonlinear Algebra Seminar**  
Dec. 2021 Max Planck Institute for Mathematics in the Sciences.  
Co-organizers: B. Sturmfels, S. Telen
- August 2021 **SIAM Minisymposium: Tensor Networks and Geometry**  
SIAM Conference on Applied Algebraic Geometry.  
Co-organizers: M. Christandl, D. Stilck-França, A. H. Werner
- June 2018 **QMath Masterclass - Tensors: Geometry and Quantum Information**  
University of Copenhagen and Niels Bohr International Academy.  
Co-organizers: S. Andersen, M. Christandl, A. H. Werner

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## Teaching experience

- 2021 **PostDoc**  
*Max Planck Institute for Mathematics in the Sciences.*  
Designing and lecturing for the course Introduction to Enumerative Geometry  
<https://sites.google.com/view/intro-enumerative-geometry/>
- 2017 – 2020 **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)

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## 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.

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## Publications

- 1 **The Geometry of Discotopes.** (w/C. Meroni)  
to appear: Le Matematiche – preprint [arXiv:2111.01241](https://arxiv.org/abs/2111.01241), 2021.
- 2 **Algebraic Compressed Sensing.** (w/P. Breiding, M. Michałek, N. Vannieuwenhoven)  
preprint [arXiv:2108.13208](https://arxiv.org/abs/2108.13208), 2021.
- 3 **Optimization at the boundary of the tensor network variety.** (w/M. Christandl, D. Stilck França, A. Werner)  
Phys. Rev. B 103 (19), 195139, (2021), [doi:10.1103/PhysRevB.103.195139](https://doi.org/10.1103/PhysRevB.103.195139).
- 4 **The Degree of Stiefel Manifolds.** (w/T. Brysiewicz)  
Enumerative Combinatorics and Applications, vol. 1(3), n. S2R20, (2021).
- 5 **Border rank non-additivity for higher order tensors.** (w/M. Christandl, M. Michałek, J. Zuiddam)  
SIAM J. Matrix Anal. Appl., 42(2), 503–527, (2021), [doi:10.1137/20M1357366](https://doi.org/10.1137/20M1357366).

- 6 **Geometric conditions for strict submultiplicativity of rank and border rank.** (w/E. Ballico, A. Bernardi, E. Ventura, A. Oneto)  
Ann. Mat. Pura ed Appl. vol. 200, 187–210, (2021), doi:10.1007/s10231-020-00991-6.
- 7 **Towards a Geometric Approach to Strassen’s Asymptotic Rank Conjecture.** (with A. Conner, J. M. Landsberg, E. Ventura, Y. Wang)  
Collectanea Math. vol. 72, 63–86, (2021), doi:10.1007/s13348-020-00280-8.
- 8 **Dimension of Tensor Network Varieties.** (w/A. Bernardi, C. De Lazzari)  
preprint arXiv:2101.03148, 2021.
- 9 **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, 2020, doi:10.1371/journal.pone.0241405.
- 10 **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.
- 11 **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.
- 12 **Tensors with maximal symmetries.** (w/A. Conner, J. M. Landsberg, E. Ventura)  
preprint arXiv:1909.09518, 2019.
- 13 **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.
- 14 **Border Waring Rank via Asymptotic Rank.** (w/M. Christandl, A. Oneto)  
preprint arXiv:1907.03487, 2019.
- 15 **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.
- 16 **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.
- 17 **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.
- 18 **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.
- 19 **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.
- 20 **Geometric Aspects of Iterated Matrix Multiplication**  
J. Algebra Vol. 461, pp.42–64, (2016), doi:10.1016/j.jalgebra.2016.04.028.
- 21 **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.
- 22 **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.

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## Selected seminars and Posters

- Dec. 2021 **Optimization on Tensor Network Varieties**  
*Workshop on Optimization Under Symmetry.* Simons Institute - Berkeley.
- Oct. 2021 **Geometry of Tensor Networks**  
*Séminaire Calcul Formel.* Université de Limoges.
- Aug. 2021 **Geometry of Direct Sums and Kronecker Powers of Tensors**  
*SIAM Conf. Applied Algebraic Geometry (SIAM AG21).* Texas A&M University - College Station, TX.
- April 2021 **Geometry of Tensor Network Varieties**  
*Algebra and Geometry Seminar.* Università degli Studi di Trieste.
- March 2021 **Border rank under direct sum: from Schönhage to tensor networks**  
*Quantum Information, Algebra and Geometry Seminar.* Università degli Studi di Trento.

- Dec. 2020 **Varieties of sums of powers, Stiefel manifolds and their degrees**  
*Algorithmic Mathematics and Complexity Theory Seminar.* TU Berlin.
- 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 Conf. 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, Algebra and Geometry 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.