# Matthew Trager

*Post-doc researcher*

*Center for Data Science, NYU*
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## Education

2014–2018 **Ph.D. in Computer Science**, *Inria (Willow team), École Normale Supérieure de Paris*.
Supervised by Jean Ponce and Martial Hebert, thesis entitled "Cameras, Shapes, and Contours: Geometric Models in Computer Vision."

2013–2014 **Master 2 in Mathematics, Machine Learning and Computer Vision (MVA)**, *École Normale Supérieure de Cachan*.
Mention: "Très bien - Félicitations" (highest honors).

2007–2012 **Specialized diploma in Mathematics**, *Scuola Normale Superiore di Pisa*.
"Classe di Scienze." Grade: 70/70.

2010–2012 **Master's degree ("Laurea Magistrale") in Mathematics**, *Università di Pisa*.
Advisor R. Dvornicich, thesis entitled "Arithmetic properties of elliptic curves over finite fields." Grade: 110/110 Summa Cum Laude.

2007–2010 **Bachelor's degree ("Laurea Triennale") in Mathematics**, *Università di Pisa*.
Advisors S. Marmi and C. Carminati, thesis entitled "Continued fractions, geodesic flows, and ergodic properties" (in Italian). Grade: 110/110 Summa Cum Laude.

## Research positions

Sept 2018- **New York University, Center for Data Science**, *Post-doc Researcher*.
Laboratory of Joan Bruna. Research on mathematical foundations of deep learning.

Nov 2017-Jan 2018 **New York University**, *Visiting Researcher*.
Collaboration with Jean Ponce, Martial Hebert, and Edouard Grave (Facebook AI) on the geometry of word embeddings.

June 2017 **Max Planck Institute Leipzig**, *Visiting Researcher*.
Collaboration with Bernd Sturmfels and Kathlén Kohn on the algebraic geometry of visual events.

Sept-Oct 2016 **Washington University of St.Louis**, *Visiting Researcher*.
Collaboration with Yasutaka Furukawa on "functional object modeling," automatically inferring dynamical components of a 3D model.

Sept-Dec 2015 **Robotics Institute, Carnegie Mellon University**, *Visiting Student*.

Apr-Sept 2014 **Inria (Team Willow)**, *Internship*.
Development and implementation of a new projective reconstruction algorithm from three views.

## Teaching

2019-2020 *Introduction to Computer Vision*, New York University, MS in Data Science (fall semester).

## Scholarships and awards

2013–2014 *Bourse "Fondation de coopération scientifique (FCS) Campus Paris-Saclay"*.
Scholarship for international students in Master's degrees partnered with IDEX Paris-Saclay.

2007-2012 *Funding from Scuola Normale Superiore*.
SNS covers all tuition fees and provides free accommodation and access to their canteen. Admissions are based on a very selective entrance exam (about 30 students in scientific disciplines are accepted every year, out of thousands of applicants).

2002-2007 *Italian Mathematics Olympiad*.
Five participations in the national phase: two gold medals, one silver, two bronze.

2006 *Italian Olympiad in Informatics*.
One participation in the national phase: silver medal.

## Selected presentations and activities

2020 *Invited speaker at "Algebraic Geometry and Machine Learning Minisymposium" in SIAM Conference on Mathematics of Data Science, Cincinnati (OH), USA*.

2019 *Organizer of "Algebraic Vision Minisymposium" in SIAM Conference on Applied Algebraic Geometry, Bern, Switzerland*.

2018 *Invited talk at "Real Algebraic Geometry and Optimization" Workshop at ICERM, Providence (RI), USA*.

2017 *Organizer and speaker at "Algebraic Vision Minisymposium" in SIAM Conference on Applied Algebraic Geometry, Atlanta (GA), USA*.

2017 *Invited talk at "Algebraic Algorithms and Applications", Pisa, Italy*.

2016 *Invited talk at AIM Workshop "Algebraic Vision", San Jose (CA), USA*.

## Publications

M. Trager*, K. Kohn*, and J. Bruna, "Pure and spurious critical points: a geometric study of linear networks," in *International Conference on Learning Representations*, 2020.

J. Kileel*, M. Trager*, and J. Bruna, "On the expressive power of deep polynomial neural networks," *Advances in Neural Information Processing Systems*, 2019.

F. Williams*, M. Trager*, D. Panozzo, C. Silva, D. Zorin, and J. Bruna, "Gradient dynamics of shallow univariate relu networks," in *Advances in Neural Information Processing Systems*, 2019.

M. Trager, M. Hebert, and J. Ponce, "Coordinate-Free Carlsson-Weinshall Duality and Relative Multi-View Geometry," in *IEEE Conference on Computer Vision and Pattern Recognition (Oral)*, 2019.

B. Osserman and M. Trager, "Multigraded cayley-chow forms," *Advances in Mathematics*, vol. 348, pp. 583–606, 2019.

M. Trager, B. Osserman, and J. Ponce, "On the solvability of viewing graphs," in *European Conference on Computer Vision*, 2018.

B. Bukh, X. Goaoc, A. Hubard, and M. Trager, "Consistent sets of lines with no colorful incidence," in *International Symposium on Computational Geometry*, 2018.

K. Kohn, B. Sturmfels, and M. Trager, "Changing views on curves and surfaces," *Acta Mathematica Vietnamica*, vol. 43, no. 1, pp. 1–29, 2018.

M. Trager, B. Sturmfels, J. Canny, M. Hebert, and J. Ponce, "General models for rational cameras and the case of two-slit projections," in *IEEE Conference on Computer Vision and Pattern Recognition*, 2017.

J. Ponce, B. Sturmfels, and M. Trager, "Congruences and concurrent lines in multi-view geometry," *Advances in Applied Mathematics*, vol. 88, pp. 62–91, 2017.

M. Trager, M. Hebert, and J. Ponce, "Consistency of silhouettes and their duals," in *IEEE Conference on Computer Vision and Pattern Recognition*, 2016.

M. Trager, J. Ponce, and M. Hebert, "Trinocular geometry revisited," *International Journal of Computer Vision*, pp. 1–19, 2016.

M. Trager, M. Hebert, and J. Ponce, "The joint image handbook," in *Proceedings of the IEEE International Conference on Computer Vision*, pp. 909–917, 2015.

## Other activities

*Fencing (Épée)* Member of the Italian National Team until 2014, and supported as an athlete of the Italian Army (Esercito Italiano). Main achievements: 5 participations in World Championships (Junior and Senior), Silver medal at the Junior World Championships in 2008, 1st place in the final Junior World Cup ranking for the year 2007-2008, 4 times Italian Champion (U-17,U-20, twice U-23).

*Musical studies* Exam of Music theory and Solfeggio, and exam "Quinto anno" of piano, at the Musical Institute "L.Boccherini" of Lucca.

## Languages

English (native), Italian (native), French (fluent).