Enrico Facca

Academic Curriculum

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Date of birth: October 30th, 1989

Current Position

2019/Now **Postdoc research fellowship**, *Centro di Ricerca Matematica Ennio De Giorgi - Scuola Normale Superiore, Pisa (Italy)*, Advisor: Michele Benzi.

Positions Held

2018/2019 **Postdoc research fellowship**, *Padova University (Italy)*, Advisor: Mario Putti.

2018 **Scholarship researcher**, *Padova University (Italy)*, Advisor: Mario Putti.

Education

2018 **PhD in Mathematics**, *Padova University (Italy)*, Supervisor: Mario Putti, Co-advisor Franco Cardin Thesis: *Biologically inspired formulation of Optimal Transport Problems.*

2014 **Master in Mathematics**, *Padova University (Italy)*, Supervisor: Mario Putti, Co-advisor Franco Cardin. Thesis: *A biology-inspired model for the Optimal Transport Problem.*

2011 **Bachelor in Mathematics**, *Padova University (Italy)*, Supervisor: Francesco Fassò. Thesis: *Reduction of vector fields invariant under Lie group action.*

Teaching

2018/2019 **Numerical calculus, Matlab laboratory assistant** , *Aerospace Engineering Bachelor, University of Padova, 24 hours lectures.*

2016 **Pre-course for Physical-Mathematics Models** , *Mathematical Engineering Master, University of Padova, six hours lectures.*

Tutoring experiences

2013/2014 **Tutor for Calculus and Linear Algebra** , *Engineering Bachelor, University of Padova, 24+24 exercise hours.*

Research interests

- Numerical solution of Optimal Transport Problems: Monge-Kantorovich Problem, Congested and Branched Transport Problems

- Biological and complex networks
- Sparse Optimization, Basis Pursuit Problem

List of Publications

PhD Thesis

Facca Enrico. *Biologically inspired formulation of Optimal Transport Problems* . 2018.

Peer-Reviewed Journal Articles

[A1] Enrico Facca and Michele Benzi. "Fast Iterative Solution of the Optimal Transport Problem on Graphs". In: *SIAM J. Sci. Comput.* (2021). Accepted.

[A2] Diego Baptista, Daniela Leite, Enrico Facca, Mario Putti, and Caterina De Bacco. "Network extraction by routing optimization". In: *Sci. Rep.* 10 (2020).

[A3] Enrico Facca, Sara Daneri, Franco Cardin, and Mario Putti. "Numerical solution of Monge–Kantorovich Equations via a Dynamic Formulation". In: *J. Scient. Comput.* 82.3 (2020), pp. 1–26.

[A4] Enrico Facca, Andreas Karrenbauer, Pavel Kolev, and Kurt Mehlhorn. "Convergence of the non-uniform directed Physarum model". In: *Theor. Comput. Sci.* 816 (2020), pp. 184–194.

[A5] Luca Bergamaschi, Enrico Facca, Ángeles Martínez Calomardo, and Mario Putti. " Spectral preconditioners for the efficient numerical solution of a continuous branched transport model". In: *J. Comput. Appl. Math.* 354 (2018), pp. 259–270.

[A6] Enrico Facca, Franco Cardin, and Mario Putti. "Towards a Stationary Monge–Kantorovich Dynamics: The Physarum Polycephalum Experience". In: *SIAM J. Appl. Math.* 78.2 (2018), pp. 651–676.

Preprints

[P1] Vincenzo Bonifaci, Enrico Facca, Frederic Folz, Andreas Karrenbauer, Pavel Kolev, Kurt Mehlhorn, Giovanna Morigi, Golnoosh Shahkarami, and Quentin Vermande. "Physarum Multi-Commodity Flow Dynamics". Under review at Theor. Comput. Sci. (ArXiv preprint available). 2020.

[P2] Alessandro Lonardi, Enrico Facca, Mario Putti, and Caterina De Bacco. "Optimal transport for multi-commodity routing on networks". Under review at Phys. Rev. Res. (ArXiv preprint available). 2020.

[P3] Enrico Facca and Federico Piazzon. "Transport Energy". (ArXiv preprint available). 2019.

[P4] Enrico Facca, Franco Cardin, and Mario Putti. "Branching structures emerging from a continuous optimal transport model". Under review at J. Comp. Phys. (ArXiv preprint available). 2018.

[P5] Enrico Facca, Franco Cardin, and Mario Putti. "Physarum Dynamics and Optimal Transport for Basis Pursuit". (ArXiv preprint available). 2018.

List of Scientific Presentations

10-14-2020 **Invited Research Seminary**, *Presentation to the Vittorio Di Federico research group*, *"Emergence of branching structures via Optimal Transport and P-Laplacians"*, Bologna (Italy).

10-02-2019 **Contributed Talk**, *European Numerical Mathematics and Advanced Applications Conference 2019*, *"Optimal Transport Tools on Surface"*, Egmood aan Zee (Netherland).

06-26-2019 **Contributed Talk**, *People in Optimal Transportation and Applications - Incontri Indam 2019* , *"A nature inspired optimization tool"*, Cortona (Italy).

04-14-2019 **Contributed Talk**, *SIAM Conference on Mathematical Computational Issues in the Geosciences*, *"Plant Root Modeling via Optimal Transport"*, Houston - Texas, USA .

04-12-2019 **Contributed Talk**, *SIAM Conference on Mathematical Computational Issues in the Geosciences*, *"Numerical Solution of L^1-Optimal Transport Problem"*, Houston - Texas, USA .

11-15-2018 **Invited Presentation**, *Optimal Transportation and Applications* , *"Biologically inspired deduction of Optimal Transport Problems"*, Pisa, Italy.

09-06-2018 **Research Seminar**, *Presentation to porous media research group*, *"Biologically inspired formulation of Optimal Transportation Problems"*, Bergen, Norway.

07-06-2018 **Contributed Talk**, *SIMAI 2018*, *"Biologically inspired formulation of Optimal Transportation Problems"*, Roma, Italy.

06-04-2018 **Contributed Talk**, *Computational Methods in Water Resources XXIII*, *"Plant root dynamics via Optimal Transport"*, Saint Malom, France.

04-05-2018 **Contributed Talk**, *Terrestrial Systems Research: Monitoring, Prediction and High Performance Computing*, *"Hydrological networks as optimal transport structures"*, Bonn, Germany .

09-11-2017 **Contributed Talk**, *SIAM Conference on Mathematical and Computational Issues in the Geo-sciences*, *"Biologically inspired formulation of Optimal Transportation Problems"*, Erlangen, Germany.

04-27-2017 **Research Seminar**, *Presentation to the Fabio Nobile research group*, *"Biologically inspired formulation of Optimal Transportation Problems"*, Lausanne, Swizerland.

12-18-2014 **Contributed Talk**, *Current Problems in fluid-dynamics and non equilibrium thermodynamics*, *"Biologically inspired formulation of Optimal Transportation Problem"*, Bressanone, Italy.

Master Thesis Co-supervision

Co-advisor with Mario Putti of the master degree thesis in Mathematics and Mathematical Engineering of Andrea Pinto (2015), Enrico Cortese (2017), Claudia Dario (2017), Riccardo Tosi (2018), Luca Berti (2018), Nicola Segala (2019).

Visiting periods

2019 **Max Planck Institute Saarbrücken, Germany**, *One week working on Polycephalum model for Basis Pursuit Problem with the research group of Kurt Mehlhorn.*

2018 **Bergen University, Norway**, *One week working on the application of the Branched Transport Problem to the study of blood vessel in the brain with the research group of Jan Martin Nordbotten.*

2016 **Orsay - Paris Sur University, France**, *Two weeks working on my doctoral dissertation with with Filippo Santambrogio.*

2015-2016 **Friedrich-Alexander-Universität Erlangen-Nürnberg Germany**, *Seven months working on my doctoral dissertation with Peter Knabner, Aldo Pratelli, and Sara Daneri.*

Organizing activities

- Organizer of a two-days workshop *"Seminari Padovani di Analisi Numerica 2018"* May 2018, Padova.

Programming/computer skills

- Advanced knowledge with Unix-based system
- Expert with Fortran, including Object-Oriented Fortran 2003-2008
- Advanced knowledge with Python and Matlab

Softwares

- **Dynamic Monge-Kantorovich Solver**: Numerical solver for the Optimal Transport Problem with transport cost equal to Euclidean Distance on 2d,3d and surface domain
- **Graph Dynamic Monge-Kantorovich Solver**: Numerical solver for the Optimal Transport Problem on graphs with transport cost equal to shortest path distance

Languages

Italian Mother tongue

	Understanding		Speaking	Writing
	Listening	Reading	-	-
English	B2	C1	B2	B2
Spanish	B2	C1	B2	B2

References

For a reference letter please contact the following persons.

- Michele Benzi (Scuola Normale Superiore, Italy)
- Giuseppe Buttazzo (University of Pisa, Italy)
- Franco Cardin (University of Padova, Italy)
- Malgorzata Peszynska (Oregon State University, USA)
- Mario Putti (University of Padova, Italy)