1 CV of the Experienced Researcher

Personal info Name: **Enrico Facca** Date of birth: **30/10/1989** Nationality: **Italian**

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1.1 Research activities resume

My main research activities are focused on the numerical solution of the Optimal Transport problems. My contributions in this field result from an original formulation I introduced in my master thesis, that later became my PhD topic, supervised by Prof. Mario Putti and Prof. Franco Cardin from University of Padova. This new formulation led to the development of accurate and efficient numerical solvers for different transport problems, in particular the Branched Transport problem. In 2019, I moved to Scuola Normale Superiore to work with Prof. Michele Benzi on solution of the sparse saddle point linear systems arising from the solution of the Optimal Transport on graphs. We showed that in this setting the Optimal Transport problem can be solved with CPU time scaling slightly more than linearly with respect to the problem size, improving previous results that suggested a quadratic time complexity.

In 2021, I joined the RASPODI (Reliable numerical approximations of dissipative systems) team at INRIA in Lille. I worked with Andrea Natale on the numerical solution of a dynamical formulation of the Optimal Transport problem via interior point methods. Combining our expertise, we designed an iterative method capable of efficiently solving large-scale problems (arXiv preprint available).

In 2023, I was awarded by the Marie Sklodowska-Curie Postdoctoral fellowship for the project **NIOT** (Network Inpaiting via Optimal Transport) with Prof. Jan Martin Nordbotten at the University of Bergen.

In parallel with my main research activities, I created an active research network, collaborating with Prof. Kurt Mehlhorn (Emeritus scientist at the Max Planck Institute for Computer Science in Saarbrücken, Germany) and Dr. Caterina de Bacco (Research Group Leader at Max Planck Institute for Intelligent Systems in Tübingen, Germany) on extensions and applications of the Optimal Transport theory.

1.1.1 Current and previous positions

01/10/2021–Now	Marie Curie Postdoc. researcher at the **University of Bergen** (Norway), supervisor: Jan Martin Nordbotten
01/10/2021–31/03/2023	Postdoc. researcher at **INRIA Lille** (France), supervisor: Andrea Natale
01/10/2019–30/09/2021	Postdoc. researcher at Centro di Ricerca Matematica Ennio De Giorgi **Scuola Normale Superiore in Pisa** (Italy), supervisor: Michele Benzi
01/05/2018–30/09/2019	Postdoc. researcher, **University of Padova** (Italy), supervisor: Mario Putti
01/01/2018–30/04/2018	Scholarship researcher, University of Padova (Italy), supervisor: Mario Putti

1.1.2 Education

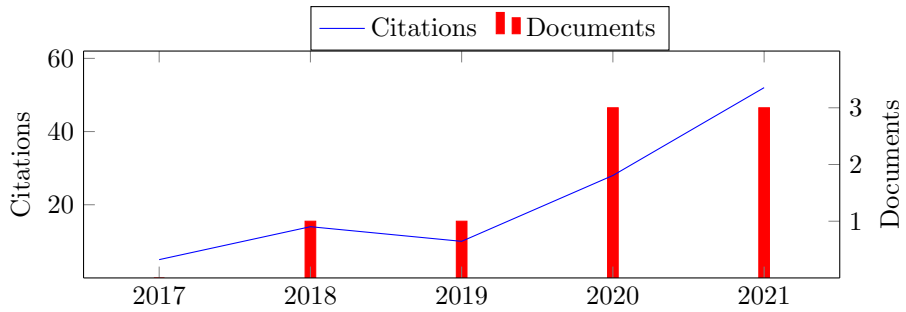
01/03/2018	PhD in Computational Mathematics, University of Padova (Italy) Dissertation: Biologically inspired formulation of Optimal Transport Problems Supervisors: Prof. Mario Putti, Franco Cardin
14/02/2014	Master degree in Mathematics, University of Padova (Italy)
21/07/2011	Bachelor degree in Mathematics, University of Padova (Italy)

1.2 Awards

Seal of excellence Marie-Curie IF 2021-2022 for the **NIOT** project (score 87.2/100).

1.3 Research records

Number of publications	Peer-reviewed journal articles: 11, Submitted: 4
Google Scholar (graph below):	h-index:7, 161 citations
Scopus:	h-index:4, 52 citations



1.3.1 Publications[1]

Journal articles on the optimal transport problem

[1] E. Facca, F. Cardin, and M. Putti. "Branching structures emerging from a continuous optimal transport model". In: Journal of Computational Physics 447 (2021). (IF: 3.55 Citations:7).

[2] E. Facca, S. Daneri, F. Cardin, and M. Putti. "Numerical solution of Monge–Kantorovich Equations via a Dynamic Formulation". In: Journal of Scientific Computing 82.3 (2020). (IF:2.59 Citations:24).

[3] E. Facca, F. Cardin, and M. Putti. "Towards a Stationary Monge–Kantorovich Dynamics: The Physarum Polycephalum Experience". In: SIAM Journal on Applied Mathematics 78.2 (2018). (IF: 2.08 Citations:28).

Journal articles on linear algebra problems

[1] E. Facca and M. Benzi. "Fast Iterative Solution of the Optimal Transport Problem on Graphs". In: SIAM Journal on Scientific Computing 43.3 (2021). (IF: 2.37 , Citations: 2).

[2] L. Bergamaschi, E. Facca, A. Martínez Calomardo, and M. Putti. "Spectral preconditioners for the efficient numerical solution of a continuous branched transport model". In: Journal of Computational and Applied Mathematics 354 (2018). (IF:2.99 Citations:21).

Journal articles on applications of the optimal transport problem

[1] A. Lonardi, E. Facca, M. Putti, and C. De Bacco. "Designing optimal networks for multicommodity transport problem". In: Physical Review Research 3 (4 2021). (IF:Not defined yet Citations:2).

[2] D. Baptista, D. Leite, E. Facca, M. Putti, and C. D. Bacco. "Network extraction by routing optimization". In: Scientific Reports 10.20806 (2020).

[3] E. Facca, A. Karrenbauer, P. Kolev, and K. Mehlhorn. "Convergence of the non-uniform directed Physarum model". In: Theoretical Computer Science 816 (2020). (IF:1.50 Citations:3).

[1] In green the documents that do not include my PhD supervisors, in blue the other ones. Citations from Google Scholar

1.3.2 List of Scientific Presentations[2]

Date	Conference/Location	Title
28/09/2022	Seminar "OptimizEd wORld" at Edinbrugh University, Edinburgh (UK)	"A short journey among Optimal Transport Problems and their numerical solution"
29/06/2022	7th IMA Conference on Numerical Linear Algebra and Optimization, Birmingham (UK)	"Iterative methods for interior point algorithms in the L^2 Optimal Transport Problem"
05/04/2022	17th Copper Mountain Conference On Iterative Methods, Virtual	"Iterative methods for interior point algorithms in the L^2 Optimal Transport Problem"
21/06/2021	8th European Congress of Mathematics, Virtual	"L^1-Optimal Transport Problem on Graphs"
02/10/2019	European Numerical Mathematics and Advanced Applications Conference 2019, Egmood aan Zee (Netherland)	"Optimal Transport Tools on Surface"
14/04/2019	SIAM Conference on Mathematical Computational Issues in the Geosciences, Houston (Texas, USA)	"Plant Root Modeling via Optimal Transport"
12/04/2019	SIAM Conference on Mathematical Computational Issues in the Geosciences, Houston (Texas, USA)	"Numerical Solution of L^1-Optimal Transport Problem"
15/11/2018	**Optimal Transportation and Applications**, **Pisa (Italy)**	"**Biologically inspired deduction of Optimal Transport Problems**"
06/07/2018	SIMAI 2018, Roma (Italy)	"Biologically inspired formulation of Optimal Transportation Problems"
04/06/2018	Computational Methods in Water Resources XXIII, Saint Malom, France	"Plant root dynamics via Optimal Transport"
05/04/2018	Terrestrial Systems Research: Monitoring, Prediction and High Performance Computing, Bonn (Germany)	"Hydrological networks as optimal transport structures"
11/09/2017	SIAM Conference on Mathematical and Computational Issues in the Geo-sciences, Erlangen, Germany	"Biologically inspired formulation of Optimal Transportation Problems"
18/12/2014	Current Problems in fluid-dynamics and non equilibrium thermodynamics, Bressanone (Italy)	"Biologically inspired formulation of Optimal Transportation Problem"

1.3.3 Mobility

Period	Hosts	Institution/Location
17–24/02/2020	Caterina de Bacco	Max Planck Institute for Intelligent Systems in Tübingen, (Germany)
04–08/03/2019	Kurt Mehlhorn	Max Plank Institute for Informatics, Saarbrüecken (Germany)
01–08/09/2018	Jan Martin Nordbotten	Department of Mathematics, University of Bergen (Norway)
11–14/06/2018	Jean Virieux, Ludovic Metivier	Institut des Sciences de la Terre ISTerre, Grenoble (France)
7-18/12/2016	Filippo Santambrogio	Department of Mathematics, University of Paris Sud (France)
01/10/2015–30/04/2016	Peter Knabner, Aldo Pratelli	Department of Mathematics, Friedrich-Alexander-Universität Erlangen-Nürnberg (Germany)

[2] Invited presentation in bold

1.3.4 Software

- DMK - Optimal transport solvers based on Dynamical Monge-Kantorovich model.
- OT-FV - Finite volumes solver for Benamou-Brenier problem.
- NextRout - Network extraction based on optimal transport tools.

1.4 Teaching and supervision

- Matlab laboratory assistant for numerical calculus
  Aerospace engineering bachelor, University of Padova (one semester, March/June 2019)
- Pre-course in physical-mathematical models
  Mathematical Engineering Master, University of Padova (6 hours, September/2016)
- Tutorship for calculus and linear algebra courses (presentation and solution of exercises)
  Engineering Bachelor, University of Padova (two semesters in total, September 2013/June 2014)
- Co-advisor of 7 master degree theses in Mathematics and Mathematical Engineering at University of Padova.

1.5 Organizing activities

Organizer of a two-days workshop "Seminari Padovani di Analisi Numerica 2018" on numerical analysis 04–05/05/2018, Padova (Italy)

1.6 General skills

Languges	English (Fluent), Italian(Native speaker), Spanish(Good), French (Basic)
Programming languages	Python, Matlab, Fortran (from Fortran 77 to object-oriented Fortran 2008)
Finite Elements software	Firedrake, Fenics
General software	Unix-based system, Git, CMake, LaTeX