

FABIO MARCUZZI

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PERSONAL DATA

Current position: tenured faculty member (Ricercatore Universitario Confermato) at the Department of Mathematics, University of Padova, Italy.

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EDUCATION

PhD in Computational Mathematics, University of Padova. Thesis: Adaptivity in the Finite Element Method 2000

Summer school on Parallel Computing, CINECA, Casalecchio di Reno (BO), 7/1999

Workshop: "Parallel Computing in Applied Fluid Mechanics", Scuola Normale Superiore, Pisa, Italy, 15-18/9/1997.

Second level University Master in Mathematics and Informatics, University of Padova 1996

Qualifying Professional National Examination for Engineers at University of Padova, Italy. 1994

Training and master degree thesis at Salvagnini SpA. Thesis: Adaptive Control of Electromechanical Systems. 1990-1991

Master Degree (Laurea) in Electronic Engineering. Specialization: Systems Theory and Data Analysis. University of Padova, Italy 1984-1991

PROFESSIONAL EXPERIENCE

Supervisor of a PhD student with a grant funded by the project 'iNEST: INTERCONNECTED NORD-EST INNOVATION ECOSYSTEM', MUR ECS00000043 (PNRR), funded by the Italian Ministry of Research, approval n. 1058 of 23.06.2022. 2022-2025

Co-supervisor of a PhD student with a grant funded by the project "Riduzione dello spreco energetico nelle attività di preparazione di alimenti e bevande" ("Reduction of energy waste in food and beverage processing", funded by the Ministry of University and Research, PON 'Ricerca e Innovazione' 2014-2020, D.M. 1061/2021. 2022-2024

Member of the Board of the PhD Program in Mathematical Sciences, University of Padova. 2021-

Supervisor of a PhD student with a grant funded by the industry (beanTech s.r.l.) on "GPU computing for modelling, optimization and learning". 2018-2021

Principal Investigator of the project "High-performance computing for Model-Based Design applied to household appliances" and Supervisor of a PhD student, both funded by the industry (Electrolux Italy s.p.a.). 2017-2020

Principal Investigator of the project "MONUFRIGO: Sviluppo di modelli numerici real-time per le applicazioni di controllo automatico nel settore refrigerazione" ("real-time numerical models of industrial refrigeration systems for automatic control applications") and Supervisor of a research fellowship, both funded by the European Social Fund, approval Giunta Regionale Regione del Veneto n. 2121 del 30-12-2015, 9/2016-8/2017

Member of the Board of the PhD Program in Information Engineering, University of Padova. 2014-2015

Co-supervisor of a PhD student with a grant funded by the Italian Ministry of Industry, law 170, track "ICT and electronic components", on GPU computing. 2008-2011

Co-founder of SimNumerica srl, a spin-off company of the University of Padua. 2008

Founder and responsible of the Laboratory for Numerical Applications (NumLab) at the Department of Mathematics, University of Padova. 2006-2009

Tenured faculty member (Ricercatore Universitario Confermato) at the Department of Mathematics, University of Padova. 2006-

Scientific coordinator of a research program for graduate students about inverse problems in computational mechanics, funded by private companies (6 annual/semestral grants have been delivered) 2006

Principal Investigator of the project "Design and coding of numerical models for microcontrollers", funded by Electrolux Home Products Italy s.p.a. (rif. A.0ES00.MARCCOMM06). 2005-2007

Invited Professor at University of Lille (France), Department of Mathematics. 12/2004 and 7/2005

Assistant Professor at the Department of Pure and Applied Mathematics, University of Padova. 2002-2006

Research Fellow at the Department of Pure and Applied Mathematics, University of Padova, for the EU project: "An Integrated System to Measure Load and Stress on Tracks during Train Transit (ROLLING)", CRAFT-CONTRACT G3ST-CT-2000-50046 ROLLING, and Coordinator of the inter-university research for the same project (Politecnico di Milano (Italy), Department of Mechanical Engineering and Universitee de Nantes (France) 1/2001-12/2002.

Research Fellow ("Assegnista") at the Department of Pure and Applied Mathematics, University of Padova 3/2000-1/2001

Visiting research associate at Stanford University (California - USA), Department of Mechanical Engineering, Division of Mechanics and Computations, (prof. Thomas J.R. Hughes) . 9/1998-3/1999

European Patent 95112646.5-2314 "Improvement in a washing machine with automatic determination of the weight of the washload", Electrolux Zanussi SpA. 1998

European Patent Application EP0707107A1 "Improvement in the arrangement used in a clothes drying apparatus to determine the drying time", Electrolux Zanussi SpA 1996

R&D engineer (embedded systems software and estimation algorithms developments) at Electrolux-Zanussi s.p.a., Porcia (PN), Italy. 1992-1997

Technology-transfer evaluation related to algorithms and software packages for the automatic control of electro-mechanical systems, Tel Aviv University spinoff at Rishon-le-Zion (Tel Aviv), Israel. 5/1991-6/1991

R&D automation engineer (control software development), Salvagnini s.p.a., Italy. 5/1991-4/1992

TEACHING ACTIVITY

Developer of the course *Numerical Linear Algebra and Learning from Data* (master level in Mathematics). The goals of the course are: provide the students with a broad knowledge about methods of linear algebra to analyze data and learn mathematical models; give to them a problem-solving perspective about applying numerical linear algebra to real data; computer laboratory exercises and assignments are a fundamental part of the course, as well as class lectures.

Developer of the course *Computational Inverse Problems* (doctoral level, engineering). The goals of the course are: provide the students with a sound methodology to tackle with ill-conditioning, a fundamental issue in inverse problems, and how to recognize it inside the mostly used computational methods in linear and nonlinear estimation and system identification. Provide the students with a brief introduction to the Finite Element Method (FEM) and give examples where the physics-awareness of mathematical models becomes a great help in the solution of inverse problems, when they are related to the estimation of unknown physical quantities.

Coordinator for the Seminar Activities of graduate students in Mathematics. Each student at the master level in Mathematics must carry out an activity chosen among a seminar, a foreign language in-depth study or additional computer skills. 2013-present

Coordinator of three Erasmus student-fluxes (University of Lille1, University of Leiden, University of Vienna) 2012-present

Instructor for *Numerical Linear Algebra and Learning from Data* (in english, master level in Mathematics) 2021-present

Instructor for *Computational Inverse Problems* (in english, doctoral level, engineering) 2013-present

Instructor for *Numerical Methods for Data Analysis* (in italian, master level in Mathematics) 2008-2021

Instructor for *computer laboratory for Numerical Analysis I* (in italian, bachelor level in Mathematics) 2020-2023

Instructor for *computer laboratory for Numerical Computing and Programming* (in italian, bachelor level in Astronomy) 2016-2019

Developer and coordinator of the course *Inverse problems in Image Analysis* (in italian, master level in Mathematics), co-taught by people from academy and industry, funded by the European Social Fund. 2008

Co-instructor for *Numerical Methods for Differential Equations* (in italian, master level in Mathematics) 2007-2011

Instructor for *computer laboratory for Numerical Analysis I* (in italian, bachelor level in Informatics) 2003-2010 and 2013-2014

Instructor for *computer laboratory for Numerical Analysis II* (in italian, bachelor level in Mathematics) 2004-2006

Instructor for *computer laboratory for Numerical Computing and Programming* (bachelor level in Material Science) 2003-2006

SUPERVISOR/CO-SUPERVISOR ACTIVITY

Ph.D. school of Mathematics (n. 5, of which 4 women and 1 man):

- Erik Chinellato (ongoing),
- Laura Rinaldi (ongoing),
- Monica Dessole, 2022 (now at CERN, Geneva-Switzerland),
Thesis Title: Topics in Numerical Linear Algebra for High-Performance Computing.
- Marta Gatto, 2021 (now Data Scientist in Milan-Italy),
Thesis Title: Numerical Methods for Model-Based Design of Physical Systems.
- Giulia Deolmi, 2011 (now at INFORM, Aachen-Germany),
Thesis Title: Computational Parabolic Inverse Problems.

Master students:

- Master's degree in Mathematics (nr. 36 theses)
- Master's degree in Electronic/Automation Engineering (nr. 1 thesis)
- Master's degree in Computer Science (nr. 4 theses)

Bachelor students:

- Degree in Mathematics (nr. 15 theses)
- Degree in Electronic/Automation Engineering (nr. 2 thesis)
- Degree in Computer Science (nr. 3 theses)

COMMUNITY OUTREACH

Co-developer and co-instructor of MOOC Pathway *Scientific Computing with Python* (in italian, https://learn.edupopen.org/eduopenv2/pathway_details.php?specialid=57); at today, more than 1600 students enrolled in the first course *Fundamental Tools*. 2018-current

Developer and coordinator of the intensive course *GPGPU computing* for students, researchers and people from industry, taught by Jacopo Pantaleoni (NVIDIA). 2013-2018

Gives invited presentations to regional high-schools about *How to do things with maths*, with reference to the applications of digital technology and numerical algorithms.

Gives invited presentations to the industry sector about technology transfer of numerical algorithms and mathematical models, e.g. in topics related to *Embedded Digital Twins* and edge-computing.

Instructor for *computer laboratory for Numerical Computing and Programming* (high-school teachers in Mathematics) 2014-2015

SERVICE TO THE DEPARTMENT AND UNIVERSITY

Member of the Committee for Degrees in Mathematics, University of Padova 2012-Present

Member of the "Gruppo Accreditamento e Valutazione" (GAV) for Degrees in Mathematics, University of Padova 2013-Present

Tutor professor for the Second level (Master) degree in Mathematics 2013-Present

Member of the "Commissione Terza Missione", of the Department of Mathematics, University of Padova, 2021-2024

Technology-transfer representative of the Department of Mathematics, University of Padova. 2015-Present

Member of the "Giunta di Dipartimento" (Director's Committee) of the Department of Mathematics, University of Padova. 2006-2008

Founder of the Numerical Analysis Laboratory (NumLab) of the Department of Mathematics, University of Padova 2006

SCIENTIFIC MEMBERSHIP

Member, Society of Industrial and Applied Mathematics (SIAM). 2021-Present

Member, Unione Matematica Italiana (UMI). 2021-Present

Member, Società Italiana di Matematica Applicata e Industriale (SIMAI). 2017-Present

Member, Istituto Nazionale di Alta Matematica - Gruppo Nazionale per il Calcolo Scientifico (INdAM-GNCS). 2003-Present

RESEARCH INTERESTS

Computational Inverse Problems: numerical methods applicable to the solution of inverse problems regarding wave propagation in solids, heat transfer, fluid-dynamics and other phenomena described by continuum mechanics: distributed, time-varying source terms estimation, boundary condition estimation; detection of interfaces/voids, distributed parameters estimation. The approach is to adopt a reference model with a strong physical interpretability, governed by Partial Differential Equations (PDEs) or Ordinary Differential Equations (ODEs), i.e. with distributed or lumped parameters, possibly surrogate or reduced-order. In this way, the estimated quantities maintain the expected physical meaning. Moreover, a special interest is in real-time solution of these problems, computable in microcontrollers (embedded/IOT systems), with applications typically categorized as *Embedded Digital Twins*.

Scientific Machine Learning: that is to blend scientific computing methods with neural learning, giving birth to an assortment of new numerical algorithms very efficient computationally, but much more interpretable in the application domain adopted, if compared to a general neural network. This is important in the context of *Computational Inverse Problems* solved in real-time, where the majority of scientific computing methods that commonly run in desktop computing platforms suffer, and properly trained neural network, instead, offer quite high performances with a relatively low request of computing power and resources.

ResearchGate: <https://www.researchgate.net/profile/Fabio-Marcuzzi>

Numerical software: <https://github.com/NLALDlab>

PUBLICATIONS

A list of publications is present in the following web sites:

Research Padua Archive: <https://www.research.unipd.it/simple-search?query=Fabio+Marcuzzi#.XIImA1S0h3-Y>

Scopus: <https://www.scopus.com/authid/detail.uri?authorId=6603548703>

Google Scholar: https://scholar.google.it/citations?hl=en&view_op=list_works&gmla=AB0lHiyf2ddMbK9TbDV3QbHLEn4FY6cmG50j_xn2QBvxJLGohE4VMo3Ks0zIttdtt-2wavf9ufbjLKhpJ7&user=LI-Pq10AAAAJ

RESEARCH PRESENTATIONS (MOST RECENT ONES)

SIAM Conference on Uncertainty Quantification (UQ24), Trieste, Italy, February 27 - March 1, 2024

9th International Congress on Information and Communication Technology (ICICT 2024), London, UK, February 19-22, 2024

BUILD-IT 2023 - BUILDing a DIgital Twin: requirements, methods, and applications, CNR Rome, Italy, October 19-20th, 2023

IACM/ECCOMAS Math 2 Product (M2P) - Emerging Technologies in Computational Science for Industry, Sustainability and Innovation, Taormina, Italy, 30th May - 1st June 2023

SIAM Conference on Computational Science and Engineering (CSE23)", February 26 - March 3, 2023, Amsterdam

SIAM Conference on Mathematics of Data Science (MDS22), September 26-30, 2022, San Diego, CA, USA

14th World Congress on Computational Mechanics (WCCM) IACM/ECCOMAS Congress 2020, 19-24 July 2020 (postponed to January 2021), Paris (France)

PARTICIPATION TO INTERDISCIPLINARY SCIENTIFIC PROJECTS (MOST RECENT ONES)

project "iNEST: INTERCONNECTED NORD-EST INNOVATION ECOSYSTEM", MUR ECS00000043 (PNRR), decree nr. 1058 del 23.06.2022, Spoke n. 9, Models, Methods, Computing Technologies for Digital Twins. *2022-2025*

POR FESR 2014-2020 project: "Smart Integration of Appliances for high quality and sustainable Food processing (SIAF)", Regione del Veneto *2017-2020*

University of Padova project: "ACTIVITY: Advanced, Control design oriented Tools for Integrated Virtual protoTYPing" *2016-2017*