Elena Bachini

Curriculum Vitae

Personal Information

Name	Elena Bachini
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Education

2020 **Ph.D. in Computational Mathematics.** University of Padua, Italy

2016 **Master's Degree in Mathematics.** University of Padua, Italy

Feb-Jul 2015. *ERASMUS+ Programme.* Instituto Superior Técnico, Lisbon, Portugal

2013 **Bachelor's Degree in Mathematics.** University of Pisa, Italy

Research experience

Current position

from Apr 2023 **Assistant professor - RTDa**
Dept. of Mathematics "Tullio Levi-Civita", University of Padua, Italy

Previous positions

Apr 2021 - Mar 2023 **Postdoctoral fellowship** at the Institute of Scientific Computing
Dept. of Mathematics, TU Dresden, Germany

Jul 2020 - Mar 2021 **Postdoctoral fellowship** for the research project "Development of a numerical model for the solution of strongly anisotropic flow and transport equations in porous media"
Dept. of Geosciences, University of Padua, Italy

Apr - Jun 2020 **Research grant** on the topic "Modelli 2D e 3D di flusso in mezzi porosi con anisotropia"
Dept. of Geosciences, University of Padua, Italy

International mobility

Sep 2018 - Mar 2019 *Visiting PhD student* at "Oden Institute for Computational Engineering and Sciences".
University of Texas at Austin, Austin (TX), USA
Working under the supervision of Prof. C. Dawson in the Computational Hydraulics Group

23 Aug - 10 Sep 2015 *VSRP - Applied Differential Equations Workshop*. KAUST, Saudi Arabia
The workshop included: lectures by KAUST faculty and research scientists, visit to the laboratory facilities, a group research project under the supervision of Prof. D. Gomes and collaborators. The work has been published in a research paper [pub1].

Awards and fellowships

2023-2026 Fixed-term assistant professorship (RTDa) within the *"RETURN - multi-Risk sciEnce for resilienT commUnities undeR a changiNg climate"* project, MUR-PNRR Extended Partnership PE5, funded by EU

2021-2023 Postdoctoral fellowship within the *"Research Unit FOR 3013"*, funded by DFG

2020-2021 Postdoctoral fellowship within the project *"Progetto di Eccellenza CARIPARO 2017"*, funded by Fondazione CARIPARO

2020 Research grant (2 months) at the Dept. of Geosciences, University of Padua, Italy

2020 Nomination from the Doctoral School of Mathematical Sciences (UniPD) to the national prize *"con.Science"*

2018 Grant for a (6 months) period abroad from *"Fondazione Ing. Aldo Gini"*

2016-2019 Doctoral scholarship (3 years), Department of Mathematics, University of Padua, Italy

2014 *ERASMUS+ Programme* scholarship for a (1 semester) period abroad

Teaching, tutoring and supervision

Teaching and tutoring

Dec 2024 (forthcoming) *"Modeling and big data for biological systems"*, doctoral course in Crop Science, University of Padua. Co-organizer and teacher (12h)

from Mar 2024 *"Calcolo Numerico"*, first cycle degree in Chemical and Materials Engineering, University of Padua. Teacher with responsibility.

Apr - Sep 2023 *"Calcolo Numerico"*, first cycle degree in Energy/Mechanical Engineering, University of Padua. Teacher (16h)

Oct 2022 - Feb 2023 *"Computational Mathematics Project"*, Computational Mathematics (master) curriculum, TU Dresden. Research assistant.

Sep 2020 - Jan 2021 *"Matematica"*, first cycle degree in Agricultural Sciences and Technology, University of Padua. Didattica integrativa (30h)

Mar - Sep 2020 *"Calcolo Numerico"*, first cycle degree in Chemical and Materials Engineering, University of Padua. Teacher (48h)

Mar- Jun 2020 *"Calcolo Numerico"*, first cycle degree in Computer Science, University of Padua. Didattica integrativa (16h)

Oct 2016 - Jan 2017 Tutor for the course *"Analisi Matematica 1"* held by Prof. O. Bernardi, University of Padua

17 Oct - 28 Nov 2014 Progetto C.A.M – Crittografia e Aritmetica Modulare.
Tutor: assistance to the participants during lectures and laboratories, University of Padua

Supervision

- Co-supervision of 1 Master's degree thesis in Civil Engineering, University of Padua:
  ◦ M. Zurini (2024). "Modellazione geometricamente intrinseca delle equazioni delle onde lunghe in acque basse e della loro approssimazione diffusiva"

- Co-supervision of 2 Master's degree thesis in Mathematics, University of Padua:
  ◦ L. Favero (2022). "Intrinsic FEM for Vector Laplacian equations"
  ◦ L. Donà (2020). "Bathymetry reconstruction via a time-dependent intrinsic shallow water model"

Workshops, schools, conferences, and seminars

Invited presentations

15-19 Jul 2024 **"SciCADE2024 - International Conference on Scientific Computation and Differential Equations"**, Singapore - invited to a minisymposium session

10-12 Jul 2024 **"GIMC SIMAI YOUNG 2024"**, Napoli, Italy - invited to a minisymposium session

26-27 Jun 2024 **AIxtreme Annual Meeting**, Politecnico di Torino, Italy - *Keynote presentation*

16 Jan 2024 **Elite Scientific Computing Program seminars**, University of Bayreuth, Germany - invited presentation

11 Jan 2024 **PhD seminar series**, TUM-IAS, Germany - invited presentation

10 Jan 2024 **Research seminar**, University of Duisburg-Essen, Germany - invited presentation

18-22 Sep 2023 **"YAMC 2023 - Third Conference of Young Applied Mathematicians"**, Siena, Italy - invited to a minisymposium session

28 Aug - 1 Sep 2023 **"SIMAI congress"**, Matera, Italy - invited to a minisymposium session

19-22 Jun 2023 **"SIAM conference - Mathematical and Computational Issues in the Geosciences"**, Bergen, Norway - invited to a minisymposium session

9 Mar 2023 **Numerical Analysis seminar**, KTH, Sweden - invited presentation

12-14 Dec 2022 **"POEMS2022 - Polytopal Element Methods in Mathematics and Engineering"**, Milan, Italy - invited to the "Lighting Talks" session

25-29 Jul 2022 **"SciCADE2022 - International Conference on Scientific Computation and Differential Equations"**, Reykjavík, Iceland - invited to a minisymposium session

11-15 Jul 2022 **"EquaDiff15"**, Brno, Czech Republic - invited to a minisymposium session

21-24 Jun 2021 **"SIAM conference - Mathematical and Computational Issues in the Geosciences"**, Milan, Italy - invited to a minisymposium session (online event)

18 Jan 2021 **Research seminar**, TU Dresden, Germany - invited presentation (online event)

11 Dec 2020 **Seminar series: "Computational Science and Engineering Seminar"**, School of Computing at the University of Leeds, Leeds, UK - invited presentation (online event)

11-14 Mar 2019 **"SIAM conference - Mathematical and Computational Issues in the Geosciences"**, Houston (TX), USA - invited in a minisymposium session

Contributed talks and posters

3-7 Jun 2024 **"ECCOMAS CONGRESS 2024 - 9^{th} European Congress on Computational Methods in Applied Sciences and Engineering"**, Lisbon, Portugal - co-organizer of a minisymposium session

4-8 Sep 2023 **"ENUMATH 2023 - European Conference on Numerical Mathematics and Advanced Applications"**, Lisbon, Portugal - co-organizer of a minisymposium session

3-5 Jul 2023 **"INTRUSION 2023 - numerIcal aNalysis, porous media and waTer ResoUrceS: a fruItful cOntamiNation"**, Bari, Italy

5-7 Jun 2023 **"COUPLED 2023 - X International Conference on Coupled Problems in Science and Engineering"**, Crete, Greece - co-organizer of a minisymposium session

31 May - 1 Jun 2023 **"CATHY Days - International workshop on coupled surface and subsurface flow in hydrology"**, San Vito di Cadore (BL), Italy

15-17 Sep 2022 **"Chemnitz Finite Element Symposium 2022 "**, Herrsching am Ammersee, Germany

23-26 May 2022 **"UMI100-800UniPD"**, Padova, Italy

7-9 Mar 2022 **"Workshop - PDEs for surfaces and Interfaces"**, Regensburg, Germany

30 Sep - 4 Oct 2019 **"ENUMATH 2019 - European Conference on Numerical Mathematics and Advanced Applications"**, Egmond aan Zee, The Netherlands - co-organizer of a minisymposium session

22 May 2019 **Graduate seminars series**, Department of Mathematics, University of Padua, Italy

15-17 May 2019 **"IperPA2019 - XVIII Italian Meeting on Hyperbolic Equations"**, Palermo, Italy

3-7 Jun 2018 **"Computational Methods in Water Resources XXII"**, Saint-Malo, France

3-4 May 2018 **"Seminari Padovani di Analisi Numerica"**, Padova, Italy

4-6 Apr 2018 **"International Conference on Terrestrial Systems Research"**, Bonn, Germany

11-14 Sep 2017 **"SIAM conference - Mathematical and Computational Issues in the Geosciences"**, Erlangen, Germany

6-8 Sep 2017 **"IperPV2017 - XVII Italian Meeting on Hyperbolic Equations"**, Pavia, Italy

12-14 Jun 2017 **"Coupled Problems 2017 - VII International Conference on Coupled Problems in Science and Engineering"**, Rhodes Island, Greece

28 May - 02 Jun 2017 **"NUMHYP17: Numerical Methods for Hyperbolic Problems"**, Monte Verità, Switzerland

26-27 Jan 2017 **"CATHY Days - International workshop on coupled surface and subsurface flow in hydrology"** San Vito di Cadore (BL), Italy

Attendance only

7-11 Oct 2023 **"PARTICLES 2023 - VIII International Conference on Particle-Based Methods"** (Particle courses and conference), Milan, Italy

11-13 Sep 2016 **"4^{th} Dolomites Workshop on Constructive Approximation and Applications"**, Alba di Canazei (TN), Italy

23 Aug - 10 Sep 2015 **"VSRP - Applied Differential Equations Workshop"**
King Abdullah University of Science and Technology - Thuwal, Saudi Arabia

19-26 Jul 2015 **"***European Consortium for Mathematics in Industry* **(ECMI) Modelling Week 2015"**, Instituto Superior Técnico - Lisbon, Portugal

Organizing activities

- **Member of the Scientific Committee** at: COUPLED 2025
- **Co-organizer of mini-symposium sessions** at: ECCOMAS 2024, ENUMATH 2023, COUPLED 2023, ENUMATH 2019

Publications (* = corresponding author)

In preparation

[pre6] E. Bachini, C. Janna, A. Larese, G. Scovazzi. Including low-dimensional features in 2D surface models. *in preparation*.

[pre5] E. Bachini, M. Camporese, A. Larese. Shallow water equations versus zero-inertia approximation within a geometrically intrinsic framework. *in preparation*.

[pre4] E. Bachini and A. Voigt. Intrinsic surface finite element method for vector Laplacian on surfaces. *in preparation*.

[pre3] E. Bachini, M.W. Farthing, M. Putti. Intrinsic surface finite element method on a time-dependent surface. *in preparation*.

[pre2] E. Bachini, C. Dawson, M.W. Farthing, M. Putti. Intrinsic Discontinuos Galerkin scheme for SWE on surfaces. *in preparation*.

[pre1] E. Bachini and M. Putti. Convergence analysis of the intrinsic surface finite element method. *arXiv*, 2022.

Publications with peer-review process.

[pub9] E. Bachini, V. Krause, I. Nitschke, A. Voigt*. Derivation and simulation of a two-phase fluid deformable surface model. *J. Fluid Mech.*, 977:A41, 2023.

[pub8] E. Bachini, P. Bandner, T. Jankuhn, M. Nestler, S. Praetorius*, A. Reusken, and A. Voigt. Diffusion of tangential tensor fields: numerical issues and influence of geometric properties. *J. Numer. Math.*, 32(1):55-75, 2023.

[pub7] E. Bachini, V. Krause, A. Voigt*. The interplay of geometry and coarsening in multicomponent lipid vesicles under the influence of hydrodynamics. *Phys. Fluids*, 35:042102, 2023.

[pub6] E. Abreu, E. Bachini*, J. Perez, and M. Putti. A geometrically intrinsic Lagrangian-Eulerian scheme for 2D shallow water equations with variable topography and discontinuous data. *Appl. Math. Comput.*, 443:127776, 2023.

[pub5] E. Bachini*, E. Bellizia, M. Putti, A. D'Alpaos, and M. Ghinassi. Two-dimensional model of flow and transport in porous media: linking heterogeneous anisotropy with stratal patterns in meandering tidal channel deposits of the Venice lagoon (Italy). *Environ. Modell. Softw.*,157:105535, 2022.

[pub4] E. Bachini*, G. Manzini, and M. Putti. Arbitrary-order intrinsic virtual element method for elliptic equations on surfaces. *Calcolo*, 58(30), 2021.

[pub3] E. Bachini*, M. W. Farthing, and M. Putti. Intrinsic finite element method for advection-diffusion-reaction equations on surfaces. *J. Comp. Phys.*, 424, 2021.

[pub2] E. Bachini and M. Putti*. Geometrically intrinsic modeling of shallow water flows. *ESAIM Math. Model. Num. Anal.*, 54(6):2125–2157, 2020.

[pub1] D. Gomes* et al. Existence of positive solutions for an approximation of stationary mean-field games. *Involve, a Journal of Mathematics*, 10(3):473–493, 2017.

Doctoral thesis

[phd] E. Bachini. *Numerical methods for Shallow Water Equations on regular surfaces*. PhD thesis, University of Padua, 2019.

Research interests and collaborations

- **Scalar-, Vector- and Tensor-valued surface PDEs:** development of numerical methods adapted to the geometry for PDEs on surfaces (intrinsic finite volumes, Discontinuous Galerkin, surface finite element, high-order virtual element methods). Applications to surface fluid flows, including shallow water equations and two-phase flow with curvature effects on stationary and evolving surfaces.
  COLLABORATORS: M. W. Farthing (U.S.Army-ERDC, US), G. Manzini (IMATI-CNR, IT - LANL, US), A. Mazzia (UniPD, IT), M. Nestler (TU Dresden, DE), S. Praetorius (TU Dresden, DE), M. Putti (UniPD, IT), A. Reusken (RWTH Aachen, DE), P. Schwering (RWTH Aachen, DE), A. Voigt (TU Dresden, DE)

- **Intrinsic Shallow Water Equations (ISWE) on fixed and moving surfaces:** modeling and development of numerical methods to solve ISWE (finite volumes with Eulerian and Lagrangian-Eulerian approach, discontinuous Galerkin scheme, continuous Galerkin with entropy-viscosity stabilization).
  COLLABORATORS: E. Abreu (UniCamp, BR), C. Dawson (UT Austin, US), M. W. Farthing (U.S.Army-ERDC, US), J. Pérez (ITM, CO), M. Putti (UniPD, IT)
- **Coupling of 1D, 2D and 3D models:** formulation and numerical solution of geometrically intrinsic models of two-dimensional overland flows for coupled surface-subsurface hydrological applications; numerical modeling of flow and transport equations in porous media with strong anisotropy; development of unfitted methods for embedded low-dimensional features.
  COLLABORATORS: E. Bellizia (UniPD, IT), M. Camporese (UniPD, IT), M. W. Farthing (U.S.Army-ERDC, US), M. Ghinassi (UniPD, IT), A. Larese (UniPD, IT), C. Paniconi (INRS, CA), M. Putti (UniPD, IT), G. Scovazzi (Duke Univ., US)

Project participations

- *"MONUGEO - Modern numerical methods for high-fidelity simulation of geohazards"* project, HORIZON-MSCA-2023-SE-01, 01/03/2025-28/02/2029
- *"ReLUIS - Rete dei Laboratori Universitari di Ingegneria Sismica e Strutturale"* project, DPC-ReLUIS 2024-2026
- *"RETURN - multi-Risk sciEnce for resilienT commUnities undeR a changiNg climate"* project, MUR-PNRR Extended Partnership PE5 on Natural Risks Next-Generation EU, 01/10/2021-31/03/2026 (Scientific head A. Larese)
- "REACT - Digital Twins of Civil StRucturEs And Protection Systems in A ClimAte Change PerspecTive" project, TUM-IAS (Germania), 01/10/2021-30/09/2024 (PI A. Larese)
- Research Unit *"Vector- and Tensor-Valued Surface PDEs" (FOR 3013)*, German Research Foundation - DFG (PI A. Voigt)
- *"NEMESIS - NumErical MEthods for the SImulation of the impact of extreme hazards on Structures and landscape"* project, University of Padua (PI A. Larese)
- *"HYDROSEM: Fluvial and tidal meanders of the Venetian-Po plain: from hydrodynamics to stratigraphy"* project (Progetto di Eccellenza CARIPARO 2017, PI M. Ghinassi)
- UniPD-SID-2016 project *"Approximation and discretization of PDEs on Manifolds for Environmental Modeling"*, University of Padua (PI M. Putti)

Institutional responsabilities

Feb-Jul 2024	Member of "Commissione Incaricata di definire i bisogni relativi all'emissione di Bandi a Cascata per Start-up, Spin-Off, Piccole Imprese Innovative", within the Spoke Water VS1, MUR-PNRR RETURN project
from Sep 2023	Member of the Teaching Board for the first cycle degree in Chemical and Materials Engineering, Dept. of Industrial Engineering, University of Padua
from Apr 2023	Member of the Department Board, Dept. of Mathematics "Tullio Levi-Civita", University of Padua
2017-2018	Representative of the PhD students in the Department Board, Dept. of Mathematics "Tullio Levi-Civita", University of Padua

Reviewer for

- AIMS Mathematics
- Applied Mathematics and Computation
- BUMI - Bollettino dell'Unione Matematica Italiana
- Communications in Computational Physics
- Computational Geosciences
- European Journal of Environmental and Civil Engineering
- ESAIM: Mathematical Modelling and Numerical Analysis
- Journal of Computational Physics
- Mathematical and Computational Applications
- Mathematics and Computers in Simulation

Scientific societies

from 2024	Member of AIMETA, member of UMI-SIMAI
from 2022	Member of "European Women in Mathematics"
from 2017	Member of the "Gruppo Nazionale Calcolo Scientifico" (GNCS) of the Istituto di Alta Matematica (INdAM)
2019-2020	Member of "SIAM Geosciences" and "SIAM Computational Science and Engineering"

Other activities

28-29 Sep 2024 (forthcoming)	Dissemination event *"Science4All"*, University of Padua Activity: "Asteroids from another space"
24-24,26-27 Jan 2024	Training programme (with OpenBadge) "Teaching4Learning@Unipd - New Faculty Course", University of Padua
30 Sep 2023	Dissemination event *"Science4All"*, University of Padua Activity: "La matematica per comprendere il mondo"

General skills

Languages	English (Fluent), Italian (Mother tongue)
Software	C++, Fortran (from Fortran 77 to object-oriented Fortran 2008), Matlab, Python, Git, CMake, LaTeX, Unix-based systems

Padova, August 2024

Elena Bachini