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Ilaria Fontana

PROFESSIONAL EXPERIENCE

Visiting Assistant Professor, Northwestern University *2022–present*
Department of Engineering Science and Applied Mathematics (ESAM)

- Collaboration with the main developers of the Dedalus project: Daniel Lecoanet, Geoff Vasil, Keaton Burns.
- Analysis of different instances of the tau spectral method. In particular, investigation of the qualitative and quantitative properties of the approximate spectrum of two eigenvalues problems with fluid dynamics applications.
- Seminars and talks at several international conferences in Europe and in the US.
- Instructor for six classes of the Northwestern multivariate integral calculus course for engineering students.
- End of the appointment: August 2024

Ph.D. Research Engineer, EDF (main French electric company) *2018–2022*
R&D Division Lab Paris-Saclay

- Development of a posteriori error estimation applied to mechanical problems modeled with PDEs, and introduction of a fully adaptive algorithm including stopping criteria for the nonlinear solver and automatic tuning of some parameters. Implementation with FreeFem++.
- Development of models for the materials and their cohesive zones, both from a theoretical point of view, and with the creation of tailored FEA tools for the industry. Implementation with Python, Fortran and the numerical simulation tool code_aster.
- Collaboration between different divisions (also outside R&D) in order to provide customer-focused solutions to the final users. This taught me how to be autonomous, organized and willing to interact and work closely with diverse audiences.
- Presentation of the results in several international conferences in Europe.

EDUCATION

Ph.D. degree, University of Montpellier and EDF Lab Paris-Saclay (CIFRE agreement) *2018–2022*
Mathématiques et Modélisation (Mathematics and Modelisation) Palaiseau (France)

- Thesis title: *Interface problems for dam modeling* (*Problèmes d'interfaces pour les ouvrages hydrauliques*)
- Topics: Finite element approximation methods for PDEs, Modeling of hydraulic structure joints with cohesive zone model, A posteriori error estimate techniques for contact problems via equilibrated stress reconstruction
- Supervisors: Daniele A. Di Pietro (University of Montpellier), Kyrylo Kazymyrenko (EDF Lab Paris-Saclay)
- Research units: IMAG - Institut Montpelliérain Alexander Grothendieck, and IMSIA - Institute of Mechanical Sciences and Industrial Application

Master degree, University of Udine *2016–2018*
Applied Mathematics Udine (Italy)

- Thesis title: *Numerical Bifurcation of Equations with Infinite Delay via Pseudospectral Collocation*
- Topics: DDEs with infinite delay, Dynamical systems generated by DDEs, Orthogonal polynomials
- Supervisor: Rossana Vermiglio
- Final grade: 110/110 cum laude

Bachelor degree, University of Udine *2013–2016*
Mathematics Udine (Italy)

- Thesis title: *Il teorema del passo di montagna* (*Mountain Pass Theorem*)
- Supervisor: Rodica Toader

- Final grade: 110/110 cum laude

TEACHING EXPERIENCES

MATH 228-2: Multiple Integration and Vector Calculus, Northwestern University *2023–2024*

- Winter 2024: Instructor for two sections - collaboration with Petia Vlahovska
- Fall 2023: Instructor for one section - collaboration with Daniel Lecoanet
- Spring 2023: Instructor for one section
- Winter 2023: Instructor for two sections - collaboration with Michael Miksis and Petia Vlahovska

PUBLICATIONS

Articles and Conference Papers

- I. Fontana, D. A. Di Pietro, *An a posteriori error analysis based on equilibrated stresses for finite element approximations of frictional contact*. Computer Methods in Applied Mechanics and Engineering, 2024, **425**:116950. DOI: 10.1016/j.cma.2024.116950
  - Preprint: arXiv, Hal
- D. A. Di Pietro, I. Fontana, K. Kazymyrenko, *A posteriori error estimates via equilibrated stress reconstructions for contact problems approximated by Nitsche's method*. Computers & Mathematics with Applications, 2022, **111**:61–80. DOI: 10.1016/j.camwa.2022.02.008.
  - Preprint: arXiv, Hal
- I. Fontana, K. Kazymyrenko, D. A. Di Pietro, *Hyperelastic nature of the Hoek–Brown criterion*.
  - Submitted. Preprint: Hal
- I. Fontana, K. Kazymyrenko, *Physics of interfaces: mechanical coupling of plasticity and damage*.
  - In preparation. Submission to a journal preview for the beginning of 2024.
- I. Fontana, R. Vermiglio, *An experimental investigation on weighted orthogonal polynomials for equations with infinite delay*.
  - In preparation. Submission to a journal preview for the beginning of 2024.

Thesis

- I. Fontana, *Interface Problems for Dam Modeling (Problèmes d'interface pour les ouvrages hydrauliques)*, Ph.D Thesis. Hal these

CONFERENCES TALKS & SEMINARS

Spring 2024 Finite Element Circus at Brown University *April 2024*
An equilibrated a posteriori error analysis for frictional contact problems Providence, RI (USA)
Volunteer presentation

Scintillae - Talk Alumni at the Scuola Superiore Universitaria Di Toppo Wassermann *December 2023*
Metodi numerici per problemi meccanici (Numerical methods for mechanical problems) Udine (Italy)
Invited talk by the Alumni Association

ICCCM 2023, 7th International Conference on Computational Contact Mechanics *July 2023*
Application of a posteriori error analysis to contact problems Turin (Italy)
Abstract selected for oral presentation

Spring 2023 Finite Element Circus at Bridgewater State University *March 2023*
Dam modeling: Application of a posteriori error analysis to contact problems Bridgewater, MA (USA)
Volunteer presentation

Seminar in the Department of Mathematics at Purdue University *December 2022*
Dam modeling: Application of a posteriori error analysis to contact problems West Lafayette, IN (USA)
Invited seminar

EFEF2020, 18th European Finite Element Fair *September 2021*
A Posteriori Error Estimation via Equilibrated Stress Reconstruction for Unilateral Contact Problems Paris (France)
Abstract selected for oral presentation

USNCCM16, 16th U.S. National Congress on Computational Mechanics *July 2021*
A Posteriori Error Estimation via Equilibrated Stress Reconstruction for Unilateral Contact Problems Online
Abstract selected for oral presentation

ADMOS 2021, 10th International Conference on Adaptive Modeling and Simulation *June 2021*
A Posteriori Error Estimation via Equilibrated Stress Reconstruction for Unilateral Contact Problems Online
Abstract selected for oral presentation

Seminar in the CDLab of the University of Udine *June 2021*
A Posteriori Error Estimation via Equilibrated Stress Reconstruction for Unilateral Contact Problems Online
Invited seminar

Congrés Français de Mécanique *August 2019*
Lois mécaniques pour les ouvrages hydrauliques (Behavioral laws for hydraulic structures) Brest (France)
Abstract selected for oral presentation

Seminar in the CDLab of the University of Udine *October 2018*
Numerical Bifurcation of Equations with Infinite Delay via Pseudospectral Collocation Udine (Italy)
Master student seminar

Seminar in the CDLab of the University of Udine *September 2018*
Laguerre-type orthogonal polynomials and transformation of the Chebyshev nodes Udine (Italy)
Master student seminar

Seminar in the CDLab of the University of Udine *July 2018*
A model describing vapour and droplets Udine (Italy)
Master student seminar

Conferences Posters

Journées scientifiques du GdR MaNu *October 2021*
A posteriori error estimates via equilibrated stress reconstructions for contact problems approximated by Nitsche's method Le Croisic (France)

Colloque National MECAMAT 2019 – Rupture des Matériaux et des Structures *January 2019*
A model describing vapour and droplets Aussois (France)

GRANTS & SCHOLARSHIPS

CIFRE convention for Ph.D. funding *2018–2022*
Industrial Agreements for Training through Research

Thesis Research fellowship *2018*
Three months of Master thesis research at the Department of Mathematics and Statistics of the University of Helsinki (Finland) in collaboration with prof. Mats Gyllenberg and with the Biomathematics research group.

"Scuola Superiore" (School for Advanced Studies) fellowship *2013–2018*
The School for Advanced Studies of the University of Udine is an institution for higher education besides the university. Admitted students follow additional courses and are examined every year on two occasions. The school covers university student fees and provides a residence for five years (Bachelor and Master degrees).

OUTREACH EXPERIENCES

Student tutor, University of Udine *2017–2018*
Student tutor for Bachelor and Master degree in Mathematics of the University of Udine. In charge of teaching assistance and outreach activities.

- Effective communicator, advertising university programs in person and on social media to diverse audiences.
- Improving the customer experience, specifically in the Mathematics Department, by identifying bottlenecks in the course load and by proposing solutions to the department directors.

Student representative, University of Udine *2014–2018*
Student representative for Bachelor and Master degree in Mathematics of the University of Udine.

TECHNICAL SKILLS

Programming languages *Python, C/C++, FreeFem++, Dedalus, Mathematica, MATLAB, Fortran, SQL, R*

Other LaTeX, *Beamer, code_aster, Linux*

LANGUAGES

Italian *Mother tongue*

English *Workplace - Daily*

French *Workplace - Daily*

Spanish *High-school*

Portuguese *Basic*