Curriculum vitae

Personal information

First name	Laura
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Scientific career description

I got my 5 years **M.Sc. in Mathematics** by the University of Alicante (UA), Spain, in 2013. After finishing it, I got an additional **Master in Industrial Mathematics**, by the University of Santiago de Compostela (USC), Spain. This Master degree gave me both the fundamentals of the well-known Finite Element Method and the expertise on mathematical modelization for the numerical simulation of several physical phenomena. My master's thesis was awarded with a qualification of 10/10. Moreover, I got a six months research position to participate in a research project at the Department of Applied Mathematics. The objective was the study and the numerical simulation of electromagnetic processes with hysteresis, with specific application on crankshafts.

In September 2016 I started as **doctoral student** in the Technical University of Catalunya (UPC), under the supervision of Prof. Ramon Codina and Prof. Joan Baiges. I was also awarded with a predoctoral national scolarship. During my PhD I worked on the development of mathematical models and numerical methods to simulate viscoelastic flows with high elasticity. I presented my thesis on 22nd September 2021 achieving a qualification of *Excellent Cum Laude*. During this period I published a total of 5 papers in high impact journals, 3 of them as first author. The work developed in my PhD was presented in several international congresses (5 in total).

In October 2021 I joined as **postdoctoral researcher** a new group at the Department of Mathematics at the University of Padova (Italy). I have been working under the supervision of Prof. Antonia Larese. This group is specialized on finite element methods and particle-based methods. This was a challenging step, moving definitely to a new scientific field of research. I am working on the Material Point Method (MPM), a kind of particle method particularly suitable for simulating large deformation (non linear) problems. All my developments were implemented in the open-source and parallelized high performance environment Kratos Multiphysics code. During this time, my research focused on the development and implementation of the Variational Multiscale Method for stabilizing incompressible materials in solid and fluid mechanics problems, using the implicit MPM. I have been involved in three research projects. Two of them are NEMESIS "Numerical methods for the simulation of the impact of extreme hazards on structures and landscape" and REACT "Digital twins of civil structures and protection systems in a climate change perspective", both related to the study of numerical methods for the simulation of the impact of extreme hazards on Structures and landscape. Lastly I have been working in the project ENIPROGETTI, which consists of the development of a mathematical and numerical model for the sensitivity analysis of the physical channel to the material parameters and to the geometry of the perforation well.

All this experience provided me with a multidisciplinary scientific background in both applied mathematics and computational engineering and gave me the basis for a future independent research career.

Current position

01/10/2021 - present

Post-doctoral researcher
Department of Mathematics "Tullio Levi Civita", Università degli Studi di Padova, Italy
Study and implementation of Full Order Models using finite elements and particle techniques for multiphysics coupled simulation. Analysis and preliminary definition of Reduced Order Models dealing with complex non linearities integrating uncertainty quantification.

Previous positions

01/09/2016 - 22/09/2021	**Pre-doctoral researcher** CIMNE, Universitat Politècnica de Catalunya, Barcelona, Spain *Development of mathematical and numerical methods to simulate viscoelastic fluid flows with high elasticity in a finite element framework, including thermal effects. These models are implemented in a high performance computing environment in Fortran objected-oriented language.*
01/12/2015 - 31/08/2016	**Solutions Assistant (SA-N1)** EVERIS, Barcelona, Spain *Technical support for a high technological databases system.*
01/09/2014 - 28/02/2015	**Research Assistant** Department of Applied Mathematics, Unidersidade de Santiago de Compostela, Santiago de Compostela, Spain *Study and numerical simulation of electromagnetic processes with hysteresis.*

Education

23/09/2021 - 22/09/2021	**Doctor of Philosophy (Ph.D.) in Structural Analysis** Department of Civil Engineering, Universitat Politècnica de Catalunya, Barcelona, Spain Title: *Numerical modelling of viscoelastic flows based on a log-conformation formulation.* Supervisors: Ramon Codina i Rovira and Joan Baiges Aznar. Qualification: Excellent *cum laude.*
01/09/2013 - 25/07/2015	**M.Sc. Industrial Mathematics** Department of Applied Mathematics, Universidade de Santiago de Compostela, Spain *Numerical methods in the finite element framework to compute different physical problems related to industry processes.*
01/09/2008 - 05/07/2013	**M.Sc. Mathematics (5 years degree)** Universidad de Alicante, Spain

Fellowships and awards

2021 - 2023	Post-doc fellowship awarded in UNIPD.
2017 - 2021	PhD thesis mark with honors (Excellent Cum Laude)
2017 - 2021	4-years Spanish government PhD scholarship. FPI: DPI2015-67857-R.

Participation in research projects

a) National and International projects:

1. **REACT.** Digital Twins Of Civil StRucturEs And Protection Systems In A ClimAte Change PerspecTive. PI: Antonia Larese. Founded by: TUM-IAS, Munich, Germany. From 01/10/2021 to 30/09/2024. (80.000€)
2. **SID2020-NEMESIS.** NumErical MEthods for the SImulation of the impact of extreme hazards on Structures and landscape Founded by: University of Padova PI: Antonia Larese. From 18/11/2020 to 31/12/2022. (39.376,70 €)
3. **ELASTIC-FLOW.** Aumento de la eficiencia en procesos de mezcla y transmisión de calor utilizando fluidos viscoelásticos en régimen laminar y turbulento. Funded by Spanish Ministry. PI:

Ramon Codina and Joan Baiges. Reference: DPI2015-67857-R. From 01/01/2016 to 31/12/2018. (125.840,00 €)

4. **FORJACEMIC.** Investigación de nuevos procesos y aleaciones de aceros microaleados para la forja en caliente de cigüeñales de automoción. Funded by CIE-GALFOR (Innterconecta). PI: Alfred Bermúdez. From 22/10/2013 to 31/12/2014.

b) Private consulting:

1. **ENIPROGETTI**. Development of a mathematical and numerical model for the sensitivity analysis of the model of the physical channel to the material parameters and to the geometry of the perforation well.Founded by ENI s.p.a. Ref. 2500042110 PI: Mario Putti From 03/05/2022 to 20/10/2022 (50.000 €)

2. Numerical analysis to estimate the optical quality degradation generated by the future European Solar Telescope (EST) over WHT (William Hershell Telescope) at Observatorio del Roque de Los Muchachos (ORM). PI: Ramon Codina and Joan Baiges. From 01/03/2020 to 31/08/2020.

3. Proyecto de consultoría con el metro de Montreal, EWE+ para el diseño de pantallas ignífugas en el metro de Montreal. Numerical analysis to determine the aerodynamic loads on the tunnel Mont-Royal wall separation. PI: Ramon Codina and Joan Baiges. From 01/03/2020 to 31/08/2020.

Memberships of scientific societies

Since 2023 Member of the Istituto Nazionale di Alta Matematica "Francesco Severi" (INDAM) - Gruppo Nazionale per il Calcolo Scientifico (GNCS)

Since 2019 Member of the Spanish Association for Numerical Methods in Engineering (SEMNI).

Since 2011 Member of National Association of Mathematic's Students (ANEM).

Publications

1. Codina R., Baiges J., Castañar I., Martínez-Suárez I., **Moreno L.** & Parada S. (2023) An embedded strategy for large scale incompressible flow simulations in moving domains. *Journal of Computational Physics,* 488, 112181. Impact Factor: 4.645 (JCR) Q1. **Remark:** In charge for some numerical computations, and the modelization of the problem to solve.

2. **Moreno L.**, Castañar I., Codina R., Baiges J. & Cattoni D. (2023) Numerical simulation of Fluid-Structure Interaction problems with viscoelastic fluids using a log-conformation reformulation. *Computer Methods in Applied Mechanics and Engineering,* 410, 115986. Impact factor 6.756 (JCR) Q1. **Remark:** Study of the fluid-structure interaction problems considering viscoelastic fluid flows with high elasticity. In charge of the theoretical part, numerical aspects, and all the numerical computations.

3. **Moreno L.**, Codina R. & Baiges J. (2021) Numerical simulation of non-isothermal viscoelastic fluid flows using a VMS stabilized Finite Element formulation. *Journal of Non-Newtonian Fluids Mechanics*, 296, 104640. Impact factor 2.82 (JCR) Q2. GS Citations: 5. **Remark:** Study from a physical point of view about the thermal coupling with viscoelastic fluid flow. In charge of all the implementations and the computational simulations.

4. Castillo E., **Moreno L.**, Codina R. & Baiges J. (2021) Stabilised Variational Multi-Scale Finite Element Formulations for Viscoelastic Fluids. *Archives of Computational Methods in Engineering*, 28, 1987-2019. Impact factor 8.171 (JCR) Q1. GS Citations: 11. **Remark:** Review about solving the viscoelastic fluid flow problem using the variational multiscale approach. In charge of writing about the work developed in others works.

5. Codina R. & **Moreno L.** (2021) Analysis of a stabilized finite element approximation for a linearized logarithm reformulation of the viscoelastic flow problem. *ESAIM. Mathematical Modelling and Numerical Analysis*, 55, 279-300. Impact factor 1.992 (JCR) Q1. GS Citations: 3. **Remark:** Numerical analysis of the formulations developed in previous works. In charge of the main demonstrations proved in the paper.

6. **Moreno L.**, Codina R. & Baiges J. (2020). Solution of transient viscoelastic flow problems approximated by a term-by-term VMS stabilized finite element formulation using time-dependent subgrid-scales. *Computer Methods in Applied Mechanics and Engineering*, 367, 113074. Impact factor 5.763 (JCR) Q1. GS Citations: 16. **Remark:** Development temporal sub-grid scales for the viscoelastic fluid flow formulation to avoid instabilities. In charge of the development, implementation and all the computations.

7. **Moreno L.**, Codina R., Baiges J. & Castillo E. (2019). Logarithmic conformation reformulation in viscoelastic flow problems approximated by a VMS-type stabilized finite element formulation. *Computer Methods in Applied Mechanics and Engineering*, 354, 706-731. Impact factor 5.763 (JCR) Q1. GS Citations: 19. **Remark:** Development of strategies for solving fluid flows with high elasticity numerically. In charge of the developed formulation, implementation and numerical examples.

Conferences

SEP 2022 L. Moreno, A. Contri, A. Larese. *A VMS-Stabilized Mixed Formulation for Non-Linear Incompressible Solid Mechanics Problems Using the Implicit Material Point Method.* Congress on Numerical Methods in Engineering (CMN 2022), Las Palmas de Gran Canaria, Spain, September 12th – 15 th 2022

JUN 2022 L. Moreno, A. Contri, A. Larese. *Stabilized mixed formulation for an implicit MPM for viscoplastic fluids by using a variational subgrid-scale framework.* 8th European Congress on Computational Methods in Applied Sciences and Engineering (ECCOMAS 2022), Oslo, Norway, June 5th - 9th 2022.

NOV 2021 L. Moreno, J. Baiges, R. Codina. *Computation of transient flow problems approximated by a VMS stabilized Finite Element formulation using time-dependent subgrid-scales for monolithic and fractional step schemes.* XLII Ibero-Latin-American Congress on Computational Methods in Engineering (CILAMCE-2021) — 3rd Pan American Congress on Computational Mechanics Computational Mechanics. Virtual Congress, Río de Janeiro, Brazil, November 9th-12th 2021.

AUG 2021 L. Moreno, J. Baiges, R. Codina. *Simulation of transient viscoelastic flow problems approximated by a VMS stabilized FE formulation using time-dependent subrid-scales.* Poster presentation and short oral talk in 25th International Congress of Theoretical and Applied Mechanics (ICTAM 2020+1). Virtual Congress, Milano, Italy, August 22-27 2021.

JUN 2021 L. Moreno, R. Codina, J. Baiges. *Thermal coupling simulations with a viscoelastic fluid flow.* Oral conference speaker in IX International Conference on Coupled Problems in Science and Engineering (COUPLED PROBLEMS 2021). Virtual congress, Chia Laguna, Sardinia (Italy), 13-16 June 2021.

JAN 2021 L. Moreno, J. Baiges, R. Codina. *Solution of transient viscoelastic flow problems approximated by a VMS stabilized finite element formulation using time-dependent subrid-scales.* Oral conference speaker in 14th World Congress on Computational Mechanics (WCCM 2020). Virtual Congress, Paris, France, 11-15 January 2021.

DEC 2019 Oral presentation in a CIMNE Coffee Talk, Barcelona, Spain. Title: *Simulating viscoelastic fluid flows with high Weissenberg number.*

JUN 2019 L. Moreno, J. Baiges, R. Codina. *Simulation of non-isothermal viscoelastic fluid flow problem using a VMS stabilized Formulation.* Oral conference speaker in the VIII International Conference on Coupled Problems in Science and Engineering (COUPLED PROBLEMS 2019),Sitges, Spain.

FEB 2018 Oral presentation in Lecture Series: Women researchers at CIMNE for the International Day of Women and Girls in Science, Barcelona, Spain. Title: *Heat transfer processes using viscoelastic fluids in laminar and turbulence regimes.*

Courses and workshops

1. *Kratos Workshop 2022*, in Deltares installations, Delft, Netherlands. Organized by Deltares company. November 9-10, 2022
2. *Workshop "Numerical Analysis of protected systems"*, in Geobrugg installations, Romanshorn, Switzerland and organized by Geobrugg company. 20/06/2022 - 22/06/2022
3. *Fortran Modernisation Workshop Programme* in Universitat Politècnica de Catalunya BarcelonaTech (Spain) and organized by NAG. 24/07/2017 - 26/07/2017
4. *X Foro de Interacción Matemática Industria* in Universidade de Santiago de Compostela, Spain. 21/11/2014

Language skills

Spanish: Native, **Catalan:** Fluent, **English:** Fluent, **Italian:** Fluent

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Software Competences

Languages: Fortran, C++, Python. **Mathematical:** Maple, Matlab. **Parallel computing:** Open MP, MPI. **Simulation:** ANSYS Fluent, COMSOL Multiphysics, KRATOS Multiphysics.

Supervision

Master thesis co-supervisor (1): An Updated Lagrangian displacement-based formulation for free surface incompressible fluids using MPM (2021), Alessandro Contri.

International collaborations

- Prof. Ramon Codina and Dr. Joan Baiges, CIMNE-UPC, Spain.
- Prof. Roland Wuechner, Technical University of Braunschweig, Germany.
- Prof K.W. Bletzinger, Chair for Structural Analysis, Technical University of Munich, Germany.
- Prof. Ernesto Castillo del Barrio, University of Santiago de Chile, Chile.