



| Part A. PERSONAL INFORMATION | | CV date | 06/11/2022 | |
|---|--|---------|-------------------------|--|
| First and Family name | María Luisa Rapún Banzo | | | |
| Social Security, Passport, ID number | | | Age | |
| Researcher codes | Open Researcher and Contributor ID (ORCID**) | | 0000-0001-5787- 5252 | |
| | SCOPUS Author ID (*) | | 13407124800 | |
| | WoS Researcher ID (*) | | K-9164-2019 | |

(*) Optional (**) Mandatory

| A.1. Current position | | | | | | |
|-----------------------------------|--|-----------------------------------|-----------|-----------------------|------------|--|
| Name of University/Institution | Universidad Politécnica de Madrid | | | | | |
| Department | Matemática aplicada a la Ingeniería Aeroespacial | | | | | |
| Address and Country | Plaza Cardenal Cisneros 3, 28040 Madrid, Spain | | | | | |
| Phone number | 653024181 | E-mail | <u>ma</u> | rialuisa.rapun@upm.es | | |
| Current position | Associated U | l Professor (Titu Iniversidad) | ılar de | From | 26/06/2010 | |
| Key words | Structural health monitoring; Defect detection; Parameter estimation; Inverse problems; Topological derivatives; Boundary element methods; Acoustic, electromagnetic, and thermal scattering; Reduced order models; Acceleration of direct numerical simulation; Proper orthogonal decomposition | | | | | |

A.2. Education

| PhD, Licensed, Graduate | University | Year |
|-------------------------|-------------------------|------|
| Mathematics, Degree | Universidad de Zaragoza | 2000 |
| PhD Applied Mathematics | Universidad de Zaragoza | 2004 |

A.3. General indicators of quality of scientific production (see instructions)

<u>"Acreditación Nacional para el cuerpo de Catedrático de Universidad (rama de conocimiento de Ciencias)": Date 27/10/2022</u>

Number of six-year research periods (sexenios): 3 (2002-2007, 2008-2013 and 2014-2019)

Total citations: 584 (Scopus), 853 (Google Scholar)

Mean citations last 5 years: 69 (Scopus)

Total JCR publications: 35 (23 Q1, 8 Q2, 4 Q3)

<u>h-index</u>: 15 (Scopus), 16 (Google Scholar)

<u>PhD thesis supervised</u>: One PhD thesis defended in 2021. I am currently supervising 1 PhD student.

Part B. CV SUMMARY (max. 3500 characters, including spaces)

I am Associate Professor (TU) in the Department of Applied Mathematics of the School of Aerospace Engineering at U. Politécnica de Madrid (UPM) since 2010. Before that, I was assistant professor at the U. Zaragoza (UZ) (2001), Pública de Navarra (2002-2005), Complutense de Madrid (2005-2006) and UPM (2006-2010). I completed my PhD in 2004 (supervised by F.J. Sayas) in Applied Mathematics at the UZ, in the PhD program of Computational Mechanics, opening my mathematical background to engineering problems. In 2004, 2006, 2007 and 2008, I visited the U. of Göttingen in Germany (one of the most prestigious universities in the field of inverse problems) for several months, the first time supported by a competitive DAAD scholarship. As a result of these visits, I redirected my research (that was focused on the development and numerical analysis of boundary element methods for solving direct problems) to the development of numerical methods for the identification and characterization of defects in damaged materials. I have worked in this topic with outstanding collaborators, both at national universities (A. Carpio-UCM, V. Selgas-U. Oviedo, J.M. Vega-UPM) and international ones (T. Hohage-U. Göttingen Germany, F. Le



Louër-U. Tech. Compiègne France, B.T. Johanson-Kinköping U.-Sweden, T.G. Dimiduk-Harvard U.-USA). Due to my incorporation to UPM, I started to work in the team led by J.M. Vega in the development of robust adaptive reduced order models for fast solution of problems in aeronautical applications. I have collaborated with several prestigious companies: General Dynamics-Santa Bárbara Sistemas (inspection of welded joints in military vehicles), Microflown (inverse vibroacoustic problems), Repsol (geophysics), Aernnova (structural health monitoring), Marine Instruments (data compression for satellite buoys data) and NASAL (removal of metal artifacts in TACs).

I supervised a PhD thesis that was defended in 2021. In the last six years I supervised 10 Master thesis and 7 degree thesis in Aerospace Engineering. Currently I am supervising one PhD and two Master thesis students.

My research interest in medium/long-term is to continue working in my two main research lines:

- Mathematical tools for processing structural health monitoring/non-destructive testing data

- Reduced order modelling applied to Aerospace problems

Part C. RELEVANT MERITS (sorted by typology)

C.1. Publications

Authors are alphabetically ordered in all my publications.

In total, 56 publications: 35 JCR (23 Q1, 8 Q2, 4 Q3) and 22 proceedings and book chapters Among them are the following (all Q1-JCR papers, cites from Scopus):

1. M.L. Rapún. On the solution of direct and inverse multiple scattering problems for mixed sond-soft, sound-hard and penetrable objects. Inverse Problems 36 (2020), art. 095014. Cites=4

2. F. Le Louër, **M.L. Rapún**. Detection of multiple impedance obstacles by non-iterative topological gradient based methods. J. Computational Physics. 388 (2019), 534-560. Cites=14

3. A. Carpio, T.G. Dimiduk, F. Le Louër, **M.L. Rapún**. When topological derivatives met regularized Gauss-newton iterations in holographic 3D imaging. J. Computational Physics. 388 (2019), 224-251. Cites=17

4. F. Le Louër, **M.L. Rapún**. Topological sensitivity for solving inverse multiple scattering problems in three-dimensional electromagnetism. Part II: Iterative method. SIAM J. on Imaging Sciences 11 (2018), 734-769. Cites=13

5. F. Le Louër, **M.L. Rapún**. Topological sensitivity for solving inverse multiple scattering problems in three-dimensional electromagnetism. Part I: One step method. SIAM J. on Imaging Sciences 10 (2017), 1291-1321. Cites=31

6. J.F. Funes, J.M. Perales, **M.L. Rapún**, J.M.Vega. Defect detection from multifrequency limited data via topological sensitivity. J. Mathematical Imaging and Vision 55 (2016) 19-35. Cites=33

7. M.L.Rapún, F. Terragni, J.M.Vega. Adaptive POD-based low-dimensional modeling supported by residual estimates. Int. J. Numer. Meth. Eng. 104 (2015) 844-868. Cites=18

8. A. Carpio, **M.L Rapún**. Hybrid topological derivative and gradient based methods for electrical impedance tomography. Inverse Problems 28 (2012) art 095010. Cites=25

9. M.L. Rapún, J.M. Vega. Reduced order models based on local POD plus Galerkin projection. J. Computational Physics 229 (2010) 3046-3063. Cites=80

10. A. Carpio, **M.L. Rapún.** Solving inhomogeneous inverse problems by topological derivative methods. Inverse Problems 2008 (24), art. 045014. Cites=83

C.2. Research projects

In total: 16 (Plan nacional: 4 full-time, 6 part-time; G. Navarra y Aragón: 6; Industry: 3) **"Plan Nacional" projects (as Pl):**

1. New tools and reliable models towards the design and assessment of efficient aircrafts. PID2020-114173RB-I00. PIs: M.L. Rapún and S. Le Clainche, UPM. Sep. 2021-today. Amount: 169400 euro

"Plan Nacional" projects (as member):

2. Mathematical models and techniques for cellular aggregates. MTM2017-84446-C2-1-R. PI:

A. Carpio, UCM. Jan. 2018 – Dec. 2020. Amount: 64977 euro

3. Efficient generation and post-processing of aeronautical databases. TRA2016-



75075-R. PIs: JM Perales and JM Vega, UPM. Jan. 2017 – Dec. 2019. Amount: 60000 euro 4. Hybrid models for bio and nanosystems. MTM2014-56948-C2-1-P. IP: A Carpio, U.

Complutense de Madrid. Jan. 2015 - Dec. 2017. Amount: 51788 euro.

5. Efficient simulation of aeronautical systems. TRA2013-45808-R. IP: JM Vega, U.

Politécnica de Madrid. Jan. 2014 - Dec. 2016. Amount: 180000 euros

6. Collective and stochastic behavior in bio and nanomaterials. FIS2011-28838-C02. IP: A Carpio, UCM. Jan 2014 - Dec 2014 (the project started in Jan. 2012, but I joined it in Jan. 2014). Amount: 100430 euro

7. Reduced models in Aerospace Engineering. TRA-2010-18054. IP: JM Vega, UPM, Jan. 2011-Dec. 2013. Amount: 121000 euro

8. Simulation and numerical analysis of evolution problems in fluid and solid mechanics. MTM-2007-63204. PI: JF Sayas, U. Zaragoza, Jan 2007-Dec 2010. Amount: 66500 euros **Other projects:**

9. New technologies, materials and processes for empennages (TEMPROCEN). CDTI, programa estratégico de consorcios de investigación empresarial nacional (CIEN). Company: Aernnova. PIs: J.M. Vega y J.M. Perales, UPM. Jan. 2014 - Dec. 2017. Amount: 187000 euros.

10. Pre-saline seismic interpretation images. Open innovation program Inspire Repsol. IP: **M.L.Rapún** (UPM). 2014. Amount: 2000 euro.

C.3. Contracts, technological or transfer merits

- Member of the board of directors (secretary) of the math-in network (Mathematics-Industry) since March 2017

- Member of the board of directors of the Spanish Society for Applied Mathematics (SEMA) since June 2019 and secretary since July 2022

C.4 International conferences, seminars and courses.

<u>In total</u>: 59 contributions in international conferences and 15 seminars Among them are the following:

1. "Fast time integration of PDEs using collocated POD and Galerkin projection on the fly". International conference on Adaptive Modelling and Simulation 2019 (ADMOS 2019). El Campello, Spain, May. 2019. Invited speaker

Topological derivatives for inverse multiple scattering problems in electromagnetism".
 Women in Applied and Computational Mathematics, L'Aquila, Italy. May 2018. Plenary speaker
 "POD with collocation on the fly". International conference on Adaptive Modelling and Simulation 2017 (ADMOS 2017). Verbania, Italy, Jun. 2017. Invited speaker

4. "Imaging by topological gradient methods", seminar at Nanjing University, China. Jun. 2017
5. "Non-invasive imaging by topological derivative based methods", seminar at Politecnico de Milano, Italy. Apr. 2016

6. "Shape reconstruction using multifrequency topological derivatives". Numerical resolution for Inverse Problems, Bilbao, Spain. Jan. 2015. Plenary speaker

7. "Iterative topological derivatives as a powerful tool for defect detection", seminar at

Laboratoire de Mathématiques Appliquées de Compiègne, Compiègne, France. Nov. 2015.

8. "Variational methods for defect detection and parameter identification", seminar at University of Concepción, Chile. Dec. 2014

9. "Topological derivatives for inverse scattering problems". Nonlinear least squares in shape optimization. Oberwolfach, Germany. Jan. 2011. Invited speaker

10. "Topological derivatives for shape and parameter reconstruction in scattering problems". XIV Jacques-Louis Lions Spanish-Frech School on Numerical Simulation in P hysics and Engineering. A Coruña, Spain, Sep. 2010. Plenary speaker

C.5. Student supervision

PhD thesis:

1. M. Pena. "Structural defect detection by thermographic inspection. March. 2021. Apto Cum Laude

2. S. Muñoz. "Numerical methods based on the computation of topological derivatives for the inspection of welded joints". Dec. 2023 (expected)



Master thesis and Aerospace Engineering degree thesis: 10 master thesis and 7 degree thesis since 2014. Among them are the following:

3. S. Colubi. "Topological derivative and neural network-based algoritmhs for defect detection in structures by processing infrared thermograms". 2020

4. S. Muñoz. "Numerical methods for welded joints inspection". 2019

5. R. Alonso. "Study of the structural health of aeronautical components by ultrasound tests."

6. J. Herrera. "Metallic artifact detection in TAC images". 2019

7. I. Utrera. "New interpolation methods for TAC sinograms affected by metallic artifacts". 2019

8. D. Lowe. "Compression systems for satellite bouys data". 2018

9. M. Pena. "Damage detection in two-dimensional structures through the analysis of thermograms". 2017

10. R. Serrano. "Multifrequency techniques for crack detection". 2014

C.6. Awards

Scientific awards

1. "Antonio del Valle Young Scientist Award 2010" from the Spanish Society for Applied Mathematics-SEMA.

2. International award "EAIP Young Scientist Award 2008" from the Eurasian Association on Inverse Problems

3. European finalist for the ECCOMAS award for the best PhD thesis of 2004 on computational methods in Applied Sciences and Engineering.

Teaching awards

4. 'Flap de oro 2020', 'Flap de oro 2022': best lecturer in the master program Industrial Mathematics at UPM

5. 'Diploma flap de oro 2015': one of the five best lecturers in *1st curse in* Aerospace Engineering at UPM

C.7 Commissions of trust

1. Associate Editor of the International Journal SEMA Journal (Elsevier)

2. Reviewer in JCR journals: Applied Mathematics and Computation, Applied Mathematical Modelling, Applied Mathematics Letters, Applied Numerical Mathematics, IMA Journal of Numerical Analysis, Information Processing in Agriculture, International Journal of Nonlinear Sciences and Numerical Simulation, International Journal of Thermal Sciences, International Journal on Geomathematics, Inverse and Ill-posed Problems, Inverse Problems, Inverse Problems in Science and Engineering, Journal of Computational and Nonlinear Dynamics, Journal of Computational Physics, Journal of Integral Equations and Applications, Plos One (see my profile at Publics).

(see my profile at Publons https://publons.com/researcher/1680009/maria-luisa-rapun/)

3. Reviewer for international projects:

- Estonian Research Council (ETAg) in 2019

- National projects "FONDECYT Regular 2016, Comisión Nacional de Investigación Científica y Tecnológica, Ministerio de Educación de Chile"

4. Reviewer for national projects: reviewer for the "Agencia Andaluza del Conocimiento, Junta de Andalucía".

5. Reviewer for postgraduate and postdoctoral scholarships for DAAD (German service for academic exchange), since 2015

6. Participant as jury of 7 PhD thesis

C.8 Teaching activities

1. Number of five-years teaching periods (quinquenios): 3 (last one in 2018)

2. Lecturer in 4 Spanish Universities (U. Zaragoza, U. Pública de Navarra, U. Complutense de Madrid, U. Politécnica de Madrid) in 14 different courses in Applied Mathematics including: Linear algebra, Calculus I, Calculus II, Numerical Methods, Numerical Analysis, Scientific Computing with Matlab, Informatics, and Partial Differential Equations.

3. Lecturer in 3 master/PhD programs: PhD program in Aerospace Engineering, Interuniversity master program in Industrial Mathematics, PhD program in Mathematical Engineering, Statistics and Operations Research, courses on Inverse Problems and Reduced Order Modelling