

Part A. PERSONAL INFORMATION

CV date

12/07/2024

First and Family name ANA MARIA CARPIO RODRIGUEZ

A.1. Current position

University/Institution	Universidad Complutense de Madrid		
Department	Departamento de Análisis Matemático y Matemática Aplicada		
Address and Country	Plaza de Ciencias 3, Madrid 28040, Spain		
Phone number		E-mail	
Current position	Full profesor (catedrático)	From	2006, Jan 21
Key words	Numerical analysis, Modeling and Simulation in biomedicine and materials, Inverse problems and imaging, Pattern formation, Multiscale problems, Nonlinear and asymptotic analysis of EDPs		

A.2. Education

PhD, Licensed, Graduate	University	Year
Licenciado (BSc+MSc) in Mathematics (Numerical Analysis)	País Vasco – Basque Country	1988
D.E.A. d'Analyse Numérique	Paris VI (Pierre et Marie Curie)	1989
PhD in Mathematics	Complutense de Madrid	1993
PhD in Mathematics	Paris VI (Pierre et Marie Curie, now Sorbonne)	1993

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

5 'sexenios activos' (research tracks), 7 PhD thesis advised

Part B. CV SUMMARY

After a predoctoral stay at Laboratoire JL Lions in Paris VI, I joined the Applied Mathematics Department at Universidad Complutense de Madrid in 1992. I received a prize to the best PhD in Mathematics (1993) and was promoted to Associate Professor in 1994. After a postdoctoral stay at OCIAM (Oxford Center for Industrial and Applied Mathematics, 1996-97), I received the SEMA (Sociedad española de Matemática Aplicada) Prize for young researchers (1998). I obtained the Habilitation (2004) and became Full Profesor of Applied Mathematics in 2006. I have been visiting scholar in Stanford (2010), Harvard (2012) and the Courant Institute at New York (2018-19). I have served in committees of national evaluation agencies: CNEAI (2008-09, 2022-23, research evaluation), ANECA (2008-14, accreditation of University professors), and Mobility Program 'Madariaga y Castillejo' (2014-17, Mathematics Coordinator) and as a Spanish representative in the ECMI Council (2020-24, European Consortium for Mathematics in Industry), being a member of the ESF College of Experts.

I have published more than 80 papers in high impact journals, work reflected in the direction of 7 PhD thesis and about 65 research projects presented by postdocs, graduate and undergraduate students. I have been principal investigator of 27 research grants, and invited speaker at 65 international conferences (21 plenaries), as well as at top research environments: Oxford, Harvard, MIT, Stanford, Duke, UC Berkeley, UC Santa Barbara, Courant Institute-NYU, Oberwolfach, Weierstrass Institute, Memorial Sloan Kettering Cancer Center... I have organized activities of international impact, such as a Conference on the occasion of the 80th birthdays of Abel Prizes P. Lax and L. Nirenberg (2006) and a Focus Program at the Fields Institute (2018).

My first papers dealt with nonlinear partial differential equations and integrodifferential equations, in particular, Navier-Stokes, vorticity and kinetic equations. I obtained L^1 regularity for Navier-Stokes equations resorting to Hardy spaces.

At Oxford, I worked on discrete models for defects in materials: large systems of coupled nonlinear differential equations. We characterized pinning and propagation of fronts in terms of bifurcations, extended our work to nerve impulse propagation failure, and later established a mathematical framework to study defects in graphene.

Using topological derivatives to generate descent strategies in shape optimization, I started a line of work in inverse problems, further developed during stays at Stanford, Harvard and NYU.

We have developed mathematical techniques for digital holography, combining topological derivatives, pde constrained optimization and a Bayesian approach to quantify uncertainty. At Harvard, I started a line on modelization, analysis and simulation of bacterial biofilms, in collaboration with the National Center of Biotechnology. Our ideas to fight chronic infections at implants received a prize from the Madrid+MIT Vision program (2013). Nowadays, we collaborate with entities from the Healthcare system to develop mathematical and computational techniques for handling medical data and images.

Part C. RELEVANT MERITS (since 2013)

C.1. Publications

31 papers in JCR journals since 2013, 13 book chapters-proceedings, 10 selected:

1- A. Carpio, G. Duro, Well posedness of fluid-solid mixture models for biofilm spread, Applied Mathematical Modelling 124, 64-85, 2023

IF: 5.000, 10/107 'Mathematics Interdisciplinary Applications, JCR 2022

2- A. Carpio, R. González-Albaladejo, Immersed boundary approach to biofilm spread on surfaces, Communications in Computational Physics 31(1), 257-292, 2022

IF: 3.791, 5/56 'Physics Mathematical', JCR 2021

3- L.L. Bonilla, A. Carpio, C. Trenado, Tracking collective cell motion by topological data analysis, PLOS Computational Biology, 16(12), e1008407, 2020.

IF: 4.475, 8/58 'Mathematical and Computational Biology', JCR 2020

4- A. Carpio, S. Iakunin, G. Stadler, Bayesian approach to inverse scattering with topological priors, Inverse Problems 36, 105001, 2020

IF: 2.407, 9/55 'Physics Mathematical', JCR 2020

5- B. Birnir, A. Carpio, E. Cebrian, P. Vidal, Dynamic energy budget approach to evaluate antibiotic effects on biofilms, Communications in Nonlinear Science and Numerical Simulation 54, 70-83, 2018

IF: 3.964, 5/254 'Mathematics Applied', JCR 2018

6- A. Carpio, T.G. Dimiduk, V. Selgas, P. Vidal, Optimization methods for in-line holography, SIAM Journal on Imaging Sciences 11 (2), 923-956, 2018

IF: 2.514, 21/254 'Mathematics Applied', JCR 2018

7- D.R. Espeso, A. Carpio, E. Martínez-García, V. de Lorenzo, Stenosis triggers spread of helical *Pseudomonas* biofilms in cylindrical flow systems, Scientific Reports 6, 27170, 2016

IF: 4.259, 10/64 'Multidisciplinary Sciences' JCR 2016

8- A. Carpio, G. Duro, Well posedness of an integrodifferential kinetic model of Fokker-Planck type for angiogenesis, Nonlinear Analysis: Real World Applications 30, 184-212, 2016

IF: 2.238, 10/257 'Mathematics Applied' JCR 2015

9- D.R. Espeso, A. Carpio, B. Einarsson, Differential growth of wrinkled biofilms, Physical Review E 91, 022710, 2015

IF: 2.252, 6/53 en 'Physics Mathematical' JCR 2015

10- L.L. Bonilla, A. Carpio, Driving Dislocations in Graphene, Science 337, 60171, 161-162

IF: 31.027, 2/ 56 'Multidisciplinary Sciences' JCR 2012

C.2. Research projects

PI of 9 projects since 2012 (4 Spanish Agency, 1 Madrid region, 1 EU, 1 Fields Institute, 2 mobility) plus local funds for the UCM group, secondary proposer of 4 networks granted:

1- Methods and models for biomedical applications, PI: A. Carpio (UCM), Spanish MICINN, grant PID2020-112796RB-C21, 01/09/2021-31/08/2025.

2- Matemática aplicada a modelos físicos y biológicos, PI: A. Carpio (UCM), UCM Excellence Group, yearly funds 2012-24.

3- Modeling and simulation of multicellular systems, PI: A. Carpio (UCM), Spanish MECD grant PRX18/00112, Mobility Program Salvador de Madariaga: Stay at the Courant Institute, New York University (USA), 01/09/2018 - 31/08/2019.

4- Mathematical models and techniques for cellular aggregates, PI: A. Carpio (UCM), Spanish MINECO grant MTM2017-84446-C2-1-R, 01/01/2018 - 31/09/2021.

5- Fields Focus Program 'Nanoscale systems and coupled phenomena', PIs: R. Melnik (WLU, Canadá), B. Birnir (UC Santa Barbara, USA), A. Carpio (UCM), M. Luskin (U. Minnesota, USA), Fields Institute for Research in Mathematical Sciences (Canadá) and National Science Foundation (NSF, USA), 01/01/2017 - 31/05/2018.

- 6-** Hybrid models for bio and nanosystems, PI: A. Carpio (UCM), Spanish MINECO grant MTM2014-56948-C2-1-P, 01/01/2015 - 31/12/2017.
- 7-** Multiscale biofilm modeling, PI: A. Carpio (UCM), EU NILS Mobility grant 001-ABEL-IM-2013, 01/07/2014 - 31/07/2015.
- 8-** Modeling and simulation of bacterial biofilms, PI: A. Carpio (UCM), Fundación Caja Madrid grant, Mobility program: Stay at Harvard University (USA), 01/03/2012 - 31/07/2012.
- 9-** Collective and stochastic behavior in bio and nanomaterials, PI: A. Carpio (UCM), Spanish MICINN grant FIS2011-28838-C02-02, 01/01/2012 - 31/12/2014.
- 10-** Thermic control microsystems in industrial applications, PIs: A. Carpio (UCM node), A. Velázquez (UPM, coordinator), Madrid Autonomous Community CAM network S2009/DPI-1559 involving UCM, UPM, CNB (CSIC), 01/01/2010 - 31/12/2013.

C.3. Contracts, technological or transfer merits

- Project 10 (S2009/DPI-1559) involved companies Boeing, Indra, Tecnologica, Oscatech, Casa-Espacio, Foindesa, Talgo.
- Paper 6 (SIAM 2018) is joint work with an experimentalist designing holographic microscopes at Harvard University, now at Tesla.
- Collaboration with the National Center of Biotechnology to design protocols to grow biofilms (<https://link.springer.com/article/10.1007/s10295-018-2070-0>) and study biofilms in medical flow systems (Paper 7, SR 2016).
- Currently working with Madrid Hospitals (see <https://mathematicsinindustry.springeropen.com/articles/10.1186/s13362-022-00119-w> for medical data studies) and with Memorial Sloan Kettering Cancer Center (see <https://www.biorxiv.org/content/10.1101/777169v1> for cancer gene data).
- Work on invasion of healthy epithelial tissue by mutated cells reproduced by the press <https://www.madrimasd.org/notiweb/noticias/un-estudio-describe-matematicamente-como-empieza-metastasis>
- Work on the mathematics of biological swarms reproduced by the press <https://www.madrimasd.org/notiweb/noticias/descubren-un-efecto-mariposa-caos-en-enjam-bres-rebanos-animales>
- Outreach events for the general public (Semana de la Ciencia, 2018), interviews (Madrid Idea 2013 MIT+Madrid Vision <https://www.madrimasd.org/cienciaysociedad/entrevistas/revista-madrimasd/detalleEmpresa.asp?id=526>, Tribuna Complutense 2021 <https://tribuna.ucm.es/news/la-profesora-ana-carpio-editora-de-un-numero-especial-de-la-revista-springer-jmi-sobre-modelos-matematicos-y-sars-cov2>), contribution to EMS Magazine 2022 <https://euromathsoc.org/magazine/articles/99>), student and public seminars (2017-23).

C.4. Direction of researchers

Since 2013, 3 PhD Students advised (plus 4 before, and 1 ongoing):

- 1-** Collective behavior of biological aggregates, R. González, UC3M, 14/07/2023 (currently postdoc at UC3M),
 - 2-** Flocking and pattern formation in active particles and epithelial tissues, C. Trenado, UC3M, 21/01/2021 (currently postdoc at Princeton University),
 - 3-** Modeling and simulation of bacterial biofilms, D Rodríguez, UC3M, 23/07/2013 (currently postdoc at CNB-CSIC),
- as well as 2 postdocs (S. Iakunin, B. Einarsson, with EU grant EEA-ABEL-03-2010), 7 master (TFM) and 35 undergraduate projects (TFG), 7 research contracts for graduate students.

C.5. Prizes and Awards

- Madrid-MIT (Massachusetts Institute of Technology) Idea Vision Program 2013 Honoric Mention for a Scientific Project in Biotechnology.
- SEMA (Sociedad Española de Matemática Aplicada) Prize for Young Researchers 1998.
- Doctoral award to best 1993 PhD Thesis in Mathematics, Universidad Complutense 1993.

C.6. Participation in international conferences (invited)

Since 2013, 6 plenary and 2 keynote talks at

- 1-** Spanish-French School Jacques Louis Lions, CIMNE (Spain), 2023,
- 2-** Workshop Mathematics of fluids, CIEM (Spain), 2022,

- 3- 2021 International Conference on Medical Imaging Science and Technology MIST, Beijing (China), 2021,
 - 4- ECMI Webinar 'Math for Industry 4.0 Models, Methods and Big Data', WIAS Berlin, 2020,
 - 5- Program 'Nanoscale Systems and Coupled Phenomena', Fields Institute for Research in Mathematical Sciences, Toronto (Canada), 2018,
 - 6- Workshop 'Analysis of dislocation models', BIRS Center of Casa Matemática, Oaxaca (CMO, Mexico) 2017,
 - 7- Conference 'Nonconvexity, Nonlocality and Incompatibility: From Materials to Biology', Pittsburgh (USA) 2017,
 - 8- Iberian Comsol Multiphysics Conference, Málaga, 2015,
- and 16 talks in Minisymposia in international conferences (SIAM, BIRS, ECMI, ICNAAM...). Organizer/committe of 2 international conferences (2017, 2023), 2 Minisymposia at international conferences (2024, 2014), and a 2 month focus program (2018).

C.7. Service in evaluation panels

- 12/2018-present, ESF (European Science Foundation) College of Expert Reviewers.
- 2024, Premios de Excelencia – Consejo Social UC3M, Ciencias Básicas.
- 2022-23 and 2008-2009, Physics and Mathematics Committee (Research evaluation), Comisión Nacional de Evaluación de la Actividad Investigadora (CNEAI).
- 07/2016-18, Mathematics Coordinator, Dirección de Evaluación y Acreditación de AAC.
- 09/2014-09/17, Mathematics Coordinator, Mobility Program 'Salvador de Madariaga y José Castillejo', Agencia Nacional de Evaluación y Calidad (ANECA).
- 10/2011-02/2014, Experimental Sciences Committee, Academia Program (Accreditation of university full professors), ANECA.
- 02/2008-02/2012, Experimental Sciences Committee, PEP Program (Accreditation of university professors), ANECA.

C.8. Service in international committees

- 2023- present, EMS topical activity group on inverse problems.
- 03/20-03/24 Spanish representative in the ECMI Council (European Consortium for Mathematics in Industry).
- 2017-18 Scientific and Organizing Committee of the 2 month Fields Focus Program 'Nanoscale systems and coupled phenomena', hosted at the Fields Institute in 2018.

C.9. Management of scientific research.

- Director of the UCM research group 'Mathematics applied to physical and biological systems' (rated as excellent by the spanish Agency ANEP), being responsible for obtaining funds for its activity, researchers and research (since 2005).

C.10. Editorial Committees

- Journal of Nonlinear, Complex and Data Science, 2022-present.
- Journal of Mathematics in Industry, Ed. Special Covid-19 issue, 2020-2021.
- International Journal of Nonlinear Sciences and Numerical Simulation 2014-2022.
- Mathematical Problems in Engineering 2014-present.
- ISRN Mathematical Analysis 2010-2014, Journal of Applied Mathematics 2014-2017.

Additional information, previous activities as well as the full list of publications can be found in my personal web page blogs.mat.ucm.es/acarpio and extended curriculum [fecyt cvn](#).