Camille Carvalho

camille.carvalho@insa-lyon.fr | camillecarvalho.org | GitHub: carvalhocamille

Current position

Associate Professor — INSA Lyon, France
Institut Camille Jordan, team MMCS — *01/2022 – Present*

Education

PhD in Applied Mathematics — 10/2012 – 12/2015
ENSTA Paris, France

- Title: Mathematical and numerical study of plasmonic structures with corners.
- Advisors: Anne-Sophie Bonnet-Ben Dhia, Patrick Ciarlet. Funded by ENSTA Paris and DGA (Direction Générale de l'Armement)

Master's degree in Applied Mathematics — 2011 – 2012
Sorbinne Université, France

- Partial Differential Equations and Numerical Analysis. Master with honors.

Engineer diploma — 2009 – 2012
ENSTA Paris, France

- Mathematics and Simulation.

Research Experience

Associate Researcher — 01/2024 – 12/2024
Applied Math Department — *University of California Merced, USA*

Assistant Researcher — 01/2023 – 12/2023
Applied Math Department — *University of California Merced, CA, USA*

Assistant Professor — 07/2018 – 12/2022
Applied Math Department — *University of California Merced, CA, USA*

Visiting Assistant Professor — 07/2016 – 06/2018
Applied Math Department — *University of California Merced, CA, USA*

- Research on close evaluation for layer potentials. Collaboration with Arnold Kim and Shilpa Khatri

Postdoctoral researcher — 01/2016 – 06/2016
CMAP - INRIA team Defi — *Ecole Polytechnique, France*

- Contour integrations for the Interior Transmission Eigenvalue Problem.
- Advisors: Lucas Chesnel and Houssem Haddard. Funded by the METAMATH ANR.

Teaching Experience

Lecturer at INSA de Lyon — 01/2022 – Present

Math SCAN first (lectures and tutorials)	*Fall 2024, 2025*
Math first year	*Spring 2022, 2023*
P2I7: numerical modeling, math module	*Spring 2023, 2024*
P2I8: signal processing, math module	*Spring 2022, 2023, 2024*
MNTES: mathematical and numerical tools for engineers	*AY 2022, 2023, 2024*
SGM-3: Math (Fourier and Laplace transforms)	*Fall 2022, 2023, 2024*

Lecturer at the University of California Merced — 07/2016 – 12/2021
Instructor of record (72h per course)

Math 122: Complex Analysis (upper division, 45 students)	*Fall 2021, 2019*
Math 150: Mathematical Modeling (upper division, 30 students)	*Spring 2021, 2020, 2019*
Math 298: Boundary Integral Equations (graduate, 10 students)	*Fall 2020*
Math 24: Differential Equations and Linear Algebra (lower division, 150 students)	*Fall 2020*

Math 131: Numerical Methods for Engineers and Scientists (upper division, 150 students) *Fall 2017, Spring 2018*
Math 23: Vector Calculus (lower division, 120 students) *Fall 2016, 2017, Spring 2017*

Teaching Assistant at ENSTA Paris 10/2012– 06/2016
Discussion section leader and grader (15h per course)
Quadratic optimization *2012 – 2016*
Stability and Control of dynamical systems *2013 – 2015*
Complex analysis *2013 – 2015*

Publications

Peer-reviewed journals

** indicates corresponding author, $^{+}$ indicates students and postdocs*

1. A.-S. Bonnet-Ben Dhia, C. Carvalho, L. Chesnel*, and P. Ciarlet Jr, *On the use of perfectly matched layers at corners for scattering problems with sign-changing coefficients*, Journal of Computational Physics, 322 (2016), pp. 224–247
2. C. Carvalho, L. Chesnel*, and P. Ciarlet Jr, *Eigenvalue problems with sign-changing coefficients*, Comptes Rendus Mathematique, 355 (2017), pp. 671–675
3. A.-S. Bonnet-Ben Dhia, C. Carvalho, and P. Ciarlet*, *Mesh requirements for the finite element approximation of problems with sign-changing coefficients*, Numerische Mathematik, 138 (2018), pp. 801–838
4. C. Carvalho, S. Khatri*, and A. D. Kim, *Asymptotic analysis for close evaluation of layer potentials*, J. Comput. Phys., 355 (2018), pp. 327–341
5. P. Sakkaplangkul^{+}, V. A. Bokil, and C. Carvalho*, *A fully fourth order accurate energy stable finite difference method for maxwell's equations in metamaterials*, IEEE Journal on Multiscale and Multiphysics Computational Techniques, 4 (2019), pp. 260–268
6. C. Carvalho*, S. Khatri, and A. D. Kim, *Asymptotic approximations for the close evaluation of double-layer potentials*, SIAM J. Sci. Comput., 42 (2020), pp. A504–A533
7. S. Khatri*, A. D. Kim, R. Cortez, and C. Carvalho, *Close evaluation of layer potentials in three dimensions*, Journal of Computational Physics, 423 (2020), p. 109798
8. C. Carvalho*, A. D. Kim, L. Lewis^{+}, and Z. Moitier^{+}, *Quadrature by Parity Asymptotic eXpansions (QPAX) for scattering by high aspect ration particles*, SIAM Multiscale Modeling and Simulation, 19 (2021), pp. 1857–1884
9. C. Carvalho*, *Modified representations for the close evaluation problem*, Mathematical and Computational Applications, 21 (2021), p. 69
10. C. Carvalho*, P. Ciarlet, and C. Scheid, *Limiting amplitude principle and resonances in plasmonic structures with corners: numerical investigation*, Computer Methods in Applied Mechanics and Engineering, 388 (2022), p. 114207
11. C. Carvalho and Z. Moitier$^{+,*}$, *Scattering resonances for unbounded transmission problems with sign-changing coefficient*, IMA Journal of Applied Mathematics, 88 (2023), pp. 215–257

Peer-reviewed Conference Proceedings

12. A.-S. Bonnet-Ben Dhia, C. Carvalho*, L. Chesenl, L. Chesnel, P. Ciarlet Jr, and X. Claeys, *Plasmonic cavity modes with sign-changing permittivity*, WAVES Tunis, (2013)
13. A.-S. Bonnet-Ben Dhia, C. Carvalho*, L. Chesnel, and P. Ciarlet Jr, *Plasmonic cavity modes: Black-hole phenomena captured by perfectly matched layers.*, PIERS Proceedings, (2013)
14. A.-S. Bonnet-Ben Dhia*, C. Carvalho, C. Chambeyron, L. Chesnel, P. Ciarlet Jr, A. Nicollet, and F. Zolla, *Curious energy losses at corners of metallic inclusions*, WAVES Karlsruhe, (2015)

15. A.-S. Bonnet-Ben Dhia, C. Carvalho*, and P. Ciarlet Jr, *Plasmonic waveguides: Tcoercivity approach for maxwell's equations*, WAVES Karlsruhe, (2015)

16. C. Carvalho*, S. Khatri, and A. D. Kim, *Local analysis of near fields in acoustic scattering*, WAVES Minneapolis, (2017)

17. C. Carvalho*, A. D. Kim, and Z. Moitier, *Quadrature by parity asymptotic expansions (qpax) for light scattering by high aspect ratio plasmonic particle*, in WAVES, 2022

18. C. Carvalho, A. Kim, and B. Latham*+, *Capturing plasmonic behaviors in light scattering by spheres using finite element methods and asymptotic quadrature*, in WAVES, 2022

19. C. Carvalho, A. Kim, and C. Mccullough*+, *Asymptotic analysis for sound-hard acoustic scattering by two closely-situated spheres*, in WAVES, 2022

20. C. Carvalho, E. A. Cortes*+, and C. Tsogka, *Boundary integral equation methods for optical cloaking models*, in WAVES, 2022

21. M. Bussonnier* and C. Carvalho, *Papyri: better documentation for the scientific ecosystem in jupyter*, in 21st Python in Science Conference (SciPy), 2022, pp. 75–82

22. B. Latham*+ and C. Carvalho, *Plane wave dg method for solving helmholtz equation in complex media*, in WAVES, 2024

23. C. Carvalho, S. Chaillat, E. A. Cortes*+, and C. Tsogka, *Fast and accurate boundary integral equation methods for the multi-layer transmission problem*, in WAVES, 2024

24. C. Carvalho*, A. Kim, and C. McCullough+, *Close evaluation of layer potentials in 3d for the multiple scattering*, in WAVES, 2024

Thesis

25. C. Carvalho, *Mathematical and numerical study of plasmonic structures with corners*, Ph.D, (2015)

Software

26. C. Carvalho*, *Subtraction_techniques* doi:10.5281/zenodo.3934284, 2020

27. Z. Moitier* and C. Carvalho, *Asymptotic_metacavity* doi:10.5281/zenodo.4716362, 2021

28. ——, *Scattering_BIE_QPAX,* doi:10.5281/zenodo.4692601, 2021

Talks

International Conferences

- Close evaluation of layer potentials in 3D for multiple scattering, WAVES, Berlin, 2024
- Quadrature by Parity Asymptotic eXpansions (QPAX) for light scattering by high aspect ratio plasmonic particle, SIAM CSE23, Amsterdam, 2023
- Quadrature by Parity Asymptotic eXpansions (QPAX) for light scattering by high aspect ratio plasmonic particle, WAVES, Palaiseau, 2022
- On the use of Perfectly Matched Layers for light scattering problems in plasmonic structures, CIRM, Marseille, 2022
- Subtraction techniques for the close evaluation of layer potentials, SIAM CSE, Spring 2021
- The Singular Complement Method for dielectric-metamaterial transmission problems, MAFELAP, London, 2019
- Asymptotic approximations for transmission boundary-value problems in plasmonic structures, EMTS, San Diego, 2019
- The Singular Complement Method for scattering problems in plasmonic structures, PIERS, Toyama, 2018
- Multiscale modeling to capture near-fields in plasmonic structures, SIAM AN18, Portland, 2018
- Mesh requirements for transmission problems with sign-changing coefficients, SIAM PD17, Baltimore, 2017
- Local analysis of near fields in acoustic scattering, WAVES, Minneapolis, 2017
- Plasmonic waveguides: T-coercivity approach for Maxwell's equations, WAVES, Karlsruhe, 2015
- Leaky modes in a closed plasmonic waveguide, Leaky Days, Palaiseau, France, 2015

- Leaky modes in a non dissipative plasmonic waveguide with a bounded cross section, OWTNM, Nice, France, 2014
- Revealing guides modes in a plasmonic waveguide using Perfectly Matched Layers at the corners, KOZWaves, Newcastle, Australia, 2014
- Plasmonic cavity modes: black-hole phenomena captured by Perfectly Matched Layers, PIERS, Stockholm, Sueden, 2013
- Plasmonic cavity modes with sign changing permittivity, WAVES, Tunis, Tunisia, 2013

Seminars and invited talks

- Scattering resonances for metamaterial cavities, JEARA, Grenoble, 2024
- Integral methods for the close evaluation problem, JO des poètes (60th anniversary conference, co-organizater), 2024
- Résonances plasmoniques pour les cavités de métamatériaux, GDR Ondes, Marseille, 2023
- Numerical methods for the close evaluation of layer potentials in three dimensions, UML-UNC Computational Math seminar, 2022
- Quadrature by Parity Asymptotic eXpansions (QPAX) for light scattering by high aspect ratio particle, MMCS team day, France, 2022
- Accurate evaluation of near-fields in plasmonic structures, Institut Camille Jordan, France, 2022
- Accurate evaluation of near-fields in plasmonic structures, University of Nice, 2021
- Accurate evaluation of near-fields in plasmonic structures, Fresnel Institute, 2020
- Limiting amplitude principle for plasmonic structures, UC Merced, 2020
- Close evaluation of layer potentials in three dimensions, FSU, 2020
- Subtraction techniques for the close evaluation of layer potentials, UC Merced, 2020
- Boundary integral methods for optical cloaking, UC Merced, 2019
- How to accurately compute near-fields in plasmonic structures, Portland State University, 2019
- Accurate evaluation of near-fields in plasmonic structures, Caltech, 2019
- Capturing near-fields in plasmonic structures with corners, BASCD, Livermore, 2018
- Asymptotic approximations of near fields in scattering problems, Tulane University, New Orleans, 2018
- The Singular Complement Method in plasmonics, INRIA Sophia-Antipolis, Nice, 2018
- Multiscale modeling to capture near-fields in plasmonic structures, ICERM, Brown, 2018.
- Close evaluation of layer potentials, Université de Rennes, France, 2018
- Multi-scale modeling to compute near-fields in plasmonic structures with corners, UC Merced, CA, 2017
- Mathematical and numerical study of plasmonic structures with corners, Oregon State University, OR, 2017
- Mathematical and numerical study of plasmonic structures with corners, UC Merced, CA, 2016
- Mesh requirements for transmission problems with sign-changing coefficients, University of Reims, 2015
- Leaky modes in a closed plasmonic waveguide, Leaky Days, Palaiseau, France, 2015
- Fredholm theory and T-coercivity, ENSTA, Palaiseau, 2014

Mentoring

Postdoctoral researchers 2018 – Present

Zoïs Moitier (Asymptotics for metamaterial cavities) *11/2019 – 10/2020*

Graduate students 2018 – Present

(PhD students and M.S. students)

Elsie Cortes (PhD, co-advised, Boundary integral equations for optical cloaking) *08/2020 – Expected 12/2025*

Amine Smidi (PhD, co-advised, Numerical methods for steady rolling) *11/2023 – 08/2024*

Benjmain Latham (PhD, Finite element methods for plasmonic particles in 3D) *08/2019 – 07/2025*

Cory McCullough (PhD, co-advised, Boundary integral methods for acoustic radiation forces) *05/2020 – 07/2025*

Lori Lewis (M.S., co-advised, Asymptotic for boundary integrals in regions of high curvature) *08/2018 – 05/2020*

Undergraduate students 2017 – Present

(Summer internships and semester independent research studies)

Elsie Cortes (Boundary integral methods for scattering) *08/2018– 12/2019*

Bianca Garibay (Nyström methods for Laplace's equation) *08/2018 – 12/2018*

Barbara Gomez-Aldrete (UROC, co-advised, Trapezoïd rule for Poisson problems) *05/2018 – 08/2018*

Jacob Stehle (co-advised) *05/2017 – 08/2017*

Tutoring at ENSTA ParisTech 2012 – 2015

Mentor for 15 students each year

Services

Co-director of Pôle de Mathématiques 2024 – Present
INSA Lyon

Committee member for Maîtres de conférence, PRAG, ATER recruitment 2024 – Present
INSA, Metz

Member of doctoral committees and PhD jury 2018–Present
8 students *ICJ, UC Merced*

Co-organizer of workshop on numerical analysis and scientific computing for EM 2025
60th anniversary conference for P. Ciarlet Jr. *IHP*

Co-organizer of the workshop Journées Ondes des Poètes 2024
60th anniversary conference for A.-S. Ben Dhia, E. Becache, C. Hazard, E. Luneville *ENSTA Paris*

Committee member for thesis selection 2024
Institut Camille Jordan

Elected member of the Math Council 2023 – Present
INSA Lyon

Elected member of the ICJ Lab Council 2023 – Present
Institut Camille Jordan

NSF panel review 2021
Participated in a review panel for the NSF DMS Applied Math program. *NSF*

Lecturer supervisor 2020 – 2022
Observing and evaluating lecturers. *UC Merced*

On-campus WSTEM faculty advisor 2019 – 2022
Advising the student organization for Women in Science Technology Engineering and Math *UC Merced*

Chair of the WSTEM faculty affairs committee 2019 – Present
Organize monthly panel discussions about WSTEM issues *UC Merced*

Co-founder and co-organizer of the Waves seminar 2018 – 2022
Bi-weekly seminars about wave propagation phenomena *UC Merced*

Co-organizer of mini-symposia at international conferences 2019 – Present
Conferences ICIAM 19, SIAM CSE 19, SIAM CSE 21

Reviewer for peer-reviewed journals 2018 – Present
J. Comp. Phys., SIAM J. Appl. Math., ESAIM M2AN, SIAM J. Imag. Sci.

Chair of the Applied Math social events 2018 – 2022
Applied Math Weekly, Mid-semester receptions, Coffe Hour *UC Merced*

Member of a hiring committee for a teaching faculty 2018 – 2020
Member for two searches *UC Merced*

Co-founder and co- organizer of the Boundary integral equation research seminar 2018 – 2020
Bi-weekly seminars about integral methods *UC Merced*

Chair of a postdoctoral hiring search 2019
UC Merced

Member of the graduate recruitment and admissions committee 2017 – 2019
Member for two recruitment sessions *UC Merced*

Applied Math seminar 2018
Co-organizer of the department's seminar *UC Merced*

Current and Pending Funding

PI, BQR INSA ($27,2k) 01/2024-12/2025
Modelisation, simulation and experimental demonstration of topological effects in nanophotonics *Co-PI: Lydie Ferrier*

PI, NSF Applied Math DMS-2009366($295k) 08/2020 – 12/2024
A novel Finite Element Toolbox for Interface Phenomena in Plasmonics *Single PI*

PI, NSF Computational Mathematics DMS-1819052($200k) 08/2018 – 07/2021
Close evaluation of layer potentials *Co-PIs: S. Khatri, A. D. Kim*

PI, UC Merced Senate Research Grant ($5,000) 08/2020 – 07/2021
Asymptotic methods for plasmonic problems *Co-PI: Z. Moitier*

PI, AWM-NSF Travel Award ($1,930) 2017
Travel award to attend the 13th International WAVES conference in Minneapolis