Camille Carvalho

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Current position

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

Education

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

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

Master's degree in Applied Mathematics — 2011 – 2012
Univeristé Pierre et Marie Curie, France

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

Engineer diploma — 2009 – 2012
ENSTA ParisTech, France

- Mathematics and Simulation.

Research Experience

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 the University of California Merced — 07/2016 – Present
Instructor of record (72h per course)

Math 298: Boundary Integral Equations (graduate, 10 students)	*Fall 2020*
Math 24: Differential Equations and Linear Algebra (lower division, 150 students)	*Fall 2020*
Math 150: Mathematical Modeling (upper division, 30 students)	*Spring 2020*
Math 122: Complex Analysis (upper division, 45 students)	*Fall 2019*
Math 150: Mathematical Modeling (upper division, 30 students)	*Spring 2019*
Math 131: Numerical Methods for Engineers and Scientists (upper division, 150 students)	*Spring 2018*
Math 131: Numerical Methods for Engineers and Scientists (upper division, 75 students)	*Fall 2017*
Math 23: Vector Calculus (lower division, 120 students)	*Fall 2017*
Math 23: Vector Calculus (lower division, 240 students)	*Spring 2017*
Math 23: Vector Calculus (lower division, 120 students)	*Fall 2016*

Teaching Assistant at ENSTA ParisTech — 10/2012– 06/2016
Discussion section leader and grader (45h per course)

Quadratic optimization	*2012 – 2016*
Stability and Control of dynamical systems	*2013 – 2015*
Complex analysis	*2013 – 2015*

Research Interests

Partial Differential Equations, Waves propagation, Electromagnetism, Scattering, Metamaterials and Plasmonics, Modelling, Numerical Analysis, Simulation and Scientific Computing, Finite Elements Method, Spectral theory, waveguides, PMLs, Kondratiev theory, Singularities, Boundary integral methods, Asymptotic analysis, High-order methods

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*, *Layer potential identities and subtraction techniques*, (submitted)
9. C. Carvalho* and Z. Moitier$^+$, *Asymptotics for metamaterial cavities and their effect on scattering*, (submitted)

Peer-reviewed Conference Proceedings

10. 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)
11. 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)
12. 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)
13. A.-S. Bonnet-Ben Dhia, C. Carvalho, and P. Ciarlet Jr, *Plasmonic waveguides: Tcoercivity approach for maxwell's equations*, WAVES Karlsruhe, (2015)
14. C. Carvalho, S. Khatri, and A. D. Kim, *Local analysis of near fields in acoustic scattering*, WAVES Minneapolis, (2017)

Other

15. C. Carvalho, *Étude mathématique et numérique de structures plasmoniques avec coins*, PhD thesis, (2015)
16. Code package for subtraction techniques (Matlab) https://doi.org/10.5281/zenodo.3934284

Talks

International Conferences

- 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

- Close evaluation of layer potentials in three dimensions, FSU, Fall 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)

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

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

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

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

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

On-campus WSTEM faculty advisor 2019 – Present
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 – Present
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.

Member of doctoral committees 2018 – Present
Member of two doctoral committees *UC Merced*

Chair of the Applied Math social events 2018 – Present
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, NSF Applied Math DMS-2009366($295k) 08/2020 – 07/2023
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, Johnson & Johnson WiSTEM2D Scholars ($150k) 2020 Pending
Simulation and Modeling of Interface problems involving metamaterials *Single PI*

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