

# MARTIN AVERSENG

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## RESEARCH POSITIONS

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**Université d'Angers, Faculté des sciences, LAREMA**  
Chargé de Recherche.

*Since 1st Oct. 2023*

## POST-DOCTORAL POSITIONS

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**University of Bath, Department of Mathematical Sciences**  
Post-doc, under the supervision of E. A. Spence.

*Sept. 2022 - Sep. 2023*

**ETH Zurich, Seminar for Applied Mathematics**  
Post-doc, under the supervision of R. Hiptmair.

*Sept. 2020 - Aug. 2022*

**Laboratoire Jacques-Louis Lions, Inria Alpines team, Paris**  
Post-doc, under the supervision of X. Claeys.

*Jan. 2020 - June 2020*

**CMAP, Ecole Polytechnique**  
Post-doc, under the supervision of F. Alouges

*Nov. 2019 - Dec 2019*

## EDUCATION

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**CMAP, Ecole Polytechnique, Palaiseau**  
PhD thesis in applied mathematics:  
*Efficient methods in acoustic scattering in 2D and 3D*  
*Preconditioning on singular domains and fast convolution.*

*Sept. 2016 - Dec. 2019*

Direction: François Alouges.

**Université Pierre et Marie Curie, Paris**  
Master's degree, Numerical analysis of partial differential equations.  
4-month research internship in Numerical Analysis, CMAP, Ecole Polytechnique  
*Under the supervision of F. Alouges (14/03/2016 - 31/07/2016)*

*Sept. 2015 - July 2016*

**IRCAM, Paris**  
Master's degree, Acoustics, signal processing, computer science applied to music.  
6-month research internship in behavioral neurosciences at ENS Ulm  
*Under the supervision of Shihab Shamma (28/03/2015 to 23/08/2015)*

*Sept. 2014 - July 2015*

**Ecole Polytechnique, Palaiseau**  
Major in applied mathematics.  
Minors in quantum and statistical physics, continuum mechanics  
5-month Research internship in vibro-acoustics at ESI Group, San Diego  
*Under the supervision of Bryce Gardner, (March-July 2013)*

*Sept. 2011 - July 2014*

**Lycée Sainte-Geneviève**  
Ecole Préparatoire, MPSI/MP  
Preparation to the competitive exams for the French engineering schools.

*Sept. 2009 - July 2011*

## PUBLICATIONS

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- Averseng, M.: Jump-preserving polynomial interpolation in non-manifold polyhedra *Submitted to Math Comp.* (2022).  
*Preprint:* <https://arxiv.org/abs/2310.09204>.
- Averseng, M., Galkowski, J. and Spence, E. A.: Non-uniform finite element meshes defined by ray dynamics for Helmholtz trapping problems. *In Preparation.*

- Averseng, M., Claeys, X. and Hiptmair, R.: Boundary Element Methods for the Laplace Hypersingular Integral Equation on Multiscreens: a two-level Substructuring Preconditioner. *Major revisions at SMAI journal of Computational Maths*  
Preprint: <https://arxiv.org/abs/2310.09204>.
- Averseng, M., Galkowski, J. and Spence, E. A.: Helmholtz FEM solutions are locally quasi-optimal modulo low frequencies *Accepted in Advances in Computational Mathematics*.  
Preprint: <https://arxiv.org/abs/2304.14737>.
- Averseng, M., Claeys, X. and Hiptmair, R.: Boundary Element Methods for the Hypersingular Integral Equation on Multiscreens: a two-level substructuring preconditioner. *Accepted with major revisions in SMAI Journal of Computational Mathematics*.  
Preprint: <https://arxiv.org/abs/2211.08223>.
- Averseng, M.: Stability of a weighted  $L^2$  projection in a weighted Sobolev norm. Accepted for publication. *Comptes Rendus Mathématique* (2022).  
Preprint: <https://math.ethz.ch/sam/research/reports.html?id=1021>.
- Averseng, M., Claeys, X. and Hiptmair, R.: Fractured Meshes. *Finite Elements in Analysis and Design* (220), paper n°103907 (2023).  
Link: <https://www.sciencedirect.com/science/article/pii/S0168874X22001809>.
- Alouges, F. and Averseng, M.: Quasi-local and frequency robust preconditioners for the Helmholtz first-kind integral equations on the disk. *ESAIM Mathematical Modeling and Numerical Analysis* (58) n°2, pp. 793–831 (2024).  
Link: <https://www.esaim-m2an.org/articles/m2an/abs/2024/02/m2an220159/m2an220159.html>.
- Alouges, F. and Averseng, M.: New preconditioners for the Laplace and Helmholtz integral equations on open curves. *Numerische Mathematik* 148, 225-292 (2021).  
Link: <https://doi.org/10.1007/s00211-021-01189-5>
- Averseng, M.: Pseudo-differential analysis of the weighted layer potentials for the Laplace and Helmholtz integral equations on open curves. Submitted to *Integral Equations and Operator Theory*.  
Preprint: <https://arxiv.org/abs/1905.13604>.
- Averseng, M.: Fast discrete convolution in  $\mathbb{R}^2$  with radial kernels using non-uniform fast Fourier transform with nonequispaced frequencies. *Numerical Algorithms* 83(1), 33-56 (2019).  
Link: <https://doi.org/10.1007/s11075-019-00670-5>.
- Bagur, S., Averseng, M., Elgueda, D., David, S., Fritz, J., Yin, P., Shamma, S., Boubenec, Y. and Ostojic, S. (2018). Go/No-Go task engagement enhances population representation of target stimuli in primary auditory cortex. *Nature Communications*, 9(1), 1-16.  
Link: <https://doi.org/10.1038/s41467-018-04839-9>.

## SOFTWARE DEVELOPMENT

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- Matlab/C++ prototype for 3D BEM simulations on multi-screens, and domain decomposition preconditioning.  
<https://github.com/MartinAverseng/multi-screen-bem3D-ddm>
- Matlab toolbox for square-root preconditioners on screens in 2D and 3D.  
<https://github.com/MartinAverseng/sqPrecondOpenCurves> (2D)  
<https://github.com/MartinAverseng/SqPrecondDiskScreen> (3D).
- Matlab implementation for generalized meshes, including fractured meshes and polygonal multi-screens in FEM simulations.  
<https://github.com/MartinAverseng/frackMeshLib>.

- Domain decomposition and parallel computation of local errors for large-scale high-frequency scattering problems (FreeFem++).  
[https://github.com/MartinAverseng/local\\_qo\\_experiments](https://github.com/MartinAverseng/local_qo_experiments)
- Matlab toolbox for fast convolution by (gradients of) radial kernels in  $R^2$ .  
<https://github.com/MartinAverseng/EBD>

## TALKS IN CONFERENCES AND SEMINARS

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- *Substructuring preconditioners in the boundary element methods at non-manifold geometries*. Invited talk in the ZHACM Colloquium <https://math.ethz.ch/sam/news-and-events/zhacm-colloquia.html>, September 2024.
- *Non-uniform Finite element meshes defined by ray dynamics for high-frequency Helmholtz trapping problems*. Talk in WAVES 2024, Berlin, July 2024.
- *Non-uniform meshes defined by ray dynamics for the FEM applied to high-frequency Helmholtz problems*. Talk at Molecular Dynamics Workshop <https://perso.math.u-pem.fr/fermanian.clotilde/workshop2024.html>
- *Hypersingular integral equations in non-manifold geometries: a preconditioning method by iterative substructuring*. Invited talk at the 28th International Domain Decomposition Conference in January 2024. In Mini-symposium "Novel Solution Techniques: Theory and Applications" organized by Blanca Ayuso De Dios and Suzanne Brenner.
- *Préconditionnement analytique pour les équation intégrales de frontière*, 2PMA seminar of January 2024, LAREMA, Angers.
- *Méthode des éléments finis appliquée à la propagation d'ondes haute-fréquence : des maillages non-uniformes définis par la dynamique des rayons*. Invited talk in November 2023 at the team seminar of the IDEFIX team of INRIA, ENSTA Paris-Saclay.
- *Local error analysis in the Finite Element Method for high-frequency wave-propagation problems*. Prize talk at the UKAN+ Mathematical Acoustics Workshop at UCL 18-19 September 2023 (5 finalists).
- *Is the FEM error smaller away from the scatterer than near it for high-frequency Helmholtz problems with trapping?*. Talk at the conference PoWER2023, Torino, July 2023.
- *Fractured Meshes*. Poster at the Journées Singulières, Nice, 2022.
- *Singular geometries, DtN map and preconditioning*. Numerical analysis seminar, University of Bath, Oct. 2022.
- *An algorithm for fast convolution by radial kernels*. Swiss Numerics Day 2022.
- *Singularités et preconditionnement en BEM*. Rencontres JCJC ondes 2020.
- *Preconditioners for integral equations on screens*. Oberwolfach workshop, "Boundary Element Methods", 2020.
- *Preconditioning Helmholtz integral equations on singular geometries*. Fast Boundary Element Methods in Industrial Applications, Sollerhaus, October 2020.
- *Éléments finis de frontière sur des domaines singuliers*. 9ème Biennale des Mathématiques Appliquées et Industrielles, May 2019.
- *New preconditioners for the Helmholtz integral equation on screens*. Fast Boundary Element Methods in Industrial Applications, Sollerhaus, April 2019.
- *Numerical resolution of boundary integral equations on some domains with singularities*. 14th International Conference on Mathematical and Numerical Aspects of Wave Propagation. Vienna, 2019.

- *Task-driven A1 plasticity in the temporal domain during performance of a click-rate discrimination task*. Poster at ARO 39th MidWinter Meeting. San Diego, February 2016.

## OTHER ATTENDED CONFERENCES

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- At the Interface between Semiclassical Analysis and Numerical Analysis of Wave Scattering Problems, Oberwolfach workshop, Sept. 2022
- Wave propagation in complex domains, UCL, March 2017.
- New trends in Integral Equations. Ecole Polytechnique, Feb. 2016.

## COURSE ORGANIZER

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- Course and exercise classes for Fourier series, L3 du parcours préparatoire au professorat des écoles.
- Computational Methods for Quantitative Finance: PDE Methods (Spring 2021). Master's course, ETH Zurich.

## TEACHING ASSISTANT

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- Exercice classes for Fourier series , L2 Mathématiques of Université d'Angers. Organized by Rodolphe Garbit. · Computer sessions for numerical analysis, L3 Mathématiques of Université d'Angers. Organized by Gilles Stüpfler.
- High-Performance Computing Lab for CSE (Spring 2022). Bachelor course, ETH Zurich. Organized by Olaf Schenk and Roger Käpelli.
- At the Interface Between Semiclassical Analysis and Numerical Analysis of Wave-Scattering Problems (Winter 2021, [course link](#)). Post-doctoral lecture at ETH Zurich. Lectures by visitor professor E. A. Spence (University of Bath).
- Optimisation linéaire et convexité. Third year of License, Jussieu (Spring 2020). Organized by Pauline Tan
- Computational mathematics. First year Bachelor at Ecole Polytechnique (Spring 2019). Organized by Aline Lefebvre-Lepot.
- Tutoring for students in second year for applied mathematics courses, Ecole Polytechnique (2018).

## SCIENTIFIC DIFFUSION

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- Co-organizer of *La tournée de Pi* in 2017, a musical show about mathematics, interlaced with mathematical recreatory talks, which toured in Paris, Lyon and Marseille, totaling almost 2000 spectators.