

Pierre-Antoine Comby

Research Scientist | Deep Learning, Inverse Problems & Medical Imaging

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SUMMARY

Research scientist (PhD, Université Paris-Saclay, CEA, Inria; ENS Paris-Saclay alumnus) working on deep learning for inverse problems and image reconstruction. Designs plug-and-play reconstruction methods for highly accelerated MRI and fMRI (IEEE ISBI, EUSIPCO), built SNAKE, a realistic fMRI simulator (Imaging Neuroscience), and co-authored work on implicit neural representations (MICCAI 2026). Builds GPU pipelines in PyTorch, CUDA and Triton, including a 50x faster end-to-end MRI reconstruction, and created MRI-NUFFT, an open-source non-Cartesian MRI library used across research centers.

PROFESSIONAL EXPERIENCE

Postdoctoral Researcher

Sep 2025 - Present

CEA Saclay, NeuroSpin, Paris-Saclay, France

- Develop estimation and correction methods for off-resonance (B0) artifacts in ultra-high-field MRI.
- Reduced MRI reconstruction time by 50x with an optimized end-to-end GPU pipeline.
- Co-authored DD-INR, a dynamics-driven implicit neural representation for accelerated whole-brain fMRI reconstruction (MICCAI 2026).
- Mentor 3 PhD students and coordinate team research activities.

Technologies: Python, PyTorch, CUDA, GPU, HPC, MRI

Freelance AI Research Consultant

Jun 2025 - Aug 2025

Karavela AI, Paris, France

- Delivered a state-of-the-art review of foundation models for fMRI-based brain decoding.
- Advised on data acquisition strategy for model training and on MRI sequence development with Pulseq.

Technologies: Foundation Models, Brain Decoding, fMRI, Pulseq

PhD Researcher

Oct 2021 - Mar 2025

CEA Saclay, NeuroSpin / Inria MIND, Paris-Saclay, France

- Developed robust plug-and-play reconstruction for non-Cartesian MRI: +4 dB PSNR over compressed sensing at 16x acceleration on fastMRI, outperforming unrolled networks trained at 4x (IEEE ISBI 2025).
- Extended it to 3D+t fMRI, improving reconstruction quality without fine-tuning (EUSIPCO 2025).
- Built SNAKE, a brain digital twin simulating fMRI acquisition and reconstruction (Imaging Neuroscience 2025).
- Created and maintain open-source Python libraries used by the research community: MRI-NUFFT, patch-denoise, brainweb-dl.
- Supervised 3 Master's students, leading to publications at international imaging conferences.

Technologies: Python, PyTorch, Deep Learning, Inverse Problems, Compressed Sensing, fMRI

Research Assistant

2019 - 2020

Karlsruhe Institute of Technology (KIT), Karlsruhe, Germany

- Worked on 3D ultrasound transmission tomography for early breast cancer screening.
- Designed a new reconstruction framework and efficient algorithms in MATLAB and C++ (SPIE Medical Imaging 2020).

Technologies: MATLAB, C++, Ultrasound Tomography

EDUCATION

PhD in Physics and Medical Imaging

Oct 2021 - Mar 2025

Université Paris-Saclay, CEA, Inria, Paris-Saclay, France

- Thesis: From Compressed Sensing to Deep Learning Based Methods for fMRI Reconstruction at Ultra-High Field.
- Advisors: Philippe Ciuciu and Alexandre Vignaud.

Master's Degree (MSc) in Signal Processing, Statistics, Medical Imaging and Machine Learning

2017 - 2021

École Normale Supérieure (ENS) Paris-Saclay, Department of Electrical Engineering, Cachan, France

- Master ATSI, research and international track, graduated Summa Cum Laude.
- ENS "Normalien" civil-servant student status, admitted through a nationwide competitive exam (top 0.1%).

PUBLICATIONS

Selected publications. Full list on [Google Scholar](#).

Conference Papers

Qiaoxin Li, Caini Pan, **Pierre-Antoine Comby**, Chaithya Giliyar, and Philippe Ciuciu. "DD-INR: Dynamics-Driven Implicit Neural Representation for Accelerated Whole-Brain Functional MRI Reconstruction". In: *Medical Image Computing and Computer Assisted Intervention (MICCAI)*. 2026. Accepted, preprint arXiv:2606.10756.

Pierre-Antoine Comby, Matthieu Terris, Alexandre Vignaud, and Philippe Ciuciu. "Plug-and-Play Reconstruction for 3D Non-Cartesian fMRI Data". In: *2025 33rd European Signal Processing Conference (EUSIPCO)*. 2025. Pages 1015–1019.

Pierre-Antoine Comby, Benjamin Lapostolle, Matthieu Terris, and Philippe Ciuciu. "Robust Plug-and-Play Methods for Highly Accelerated Non-Cartesian MRI Reconstruction". In: *2025 IEEE 22nd International Symposium on Biomedical Imaging (ISBI)*. 2025. Pages 1–5.

Zaineb Amor, **Pierre-Antoine Comby**, Caroline Le Ster, Alexandre Vignaud, and Philippe Ciuciu. "Non-Cartesian Non-Fourier fMRI Imaging for High-Resolution Retinotopic Mapping at 7 Tesla". In: *2023 IEEE 9th International Workshop on Computational Advances in Multi-Sensor Adaptive Processing (CAMSAP)*. 2023.

Pierre-Antoine Comby, Zaineb Amor, Alexandre Vignaud, and Philippe Ciuciu. "Denoising of fMRI Volumes Using Local Low Rank Methods". In: *2023 IEEE 20th International Symposium on Biomedical Imaging (ISBI)*. 2023.

T. Hopp, F. Zuch, **P.-A. Comby**, and N. V. Ruiter. "Fat Ray Ultrasound Transmission Tomography: Preliminary Experimental Results with Simulated Data". In: *Medical Imaging 2020: Ultrasonic Imaging and Tomography*. Volume 11319. International Society for Optics and Photonics, 2020. Page 113190M.

Journal Articles

Pierre-Antoine Comby, Guillaume Daval-Fr  rot, Caini Pan, Asma Tanabene, L  na Oudjman, Matteo Cencini, Philippe Ciuciu, and Chaithya Giliyar. "MRI-NUFFT: Doing Non-Cartesian MRI Has Never Been Easier". In: *Journal of Open Source Software* 10.108 (2025), page 7743.

Pierre-Antoine Comby, Alexandre Vignaud, and Philippe Ciuciu. "SNAKE: A Modular Realistic fMRI Data Simulator from the Space-Time Domain to k-Space and Back". In: *Imaging Neuroscience* (2025).

OPEN-SOURCE PROJECTS

MRI-NUFFT (130+ GitHub stars, 30 forks)

github.com/mind-inria/mri-nufft

- Efficient Python library for non-Cartesian MRI reconstruction with GPU backends, used in multiple research centers.

Technologies: Python, PyTorch, CUDA, GPU

patch-denoise

github.com/paquiteau/patch-denoising

- Benchmarked and improved local low-rank denoising methods for fMRI.
- Achieved a 2000x speedup over the reference CPU implementation with custom Triton GPU kernels.
- Packaged for open-source neuroscience standards (BIDS).

Technologies: PyTorch, Triton, GPU

SNAKE-fMRI

github.com/mind-inria/snake-fmri

- Digital twin for functional MRI acquisition and reconstruction.
- Basis for multiple publications of the research group and two subsequent PhD theses.

Technologies: Python, Simulation, GPU, HPC

Contributions to Open-Source Software

- Issues and pull requests to PyTorch, Matplotlib, CuPy and DeepInverse.

AWARDS AND INVITED TALKS

Invited Talk, ISMRM 2026

Open-source software for non-Cartesian MRI (MRI-NUFFT). Also invited at workshops on open-source MRI software.

2026

Best Reproducible Abstract Award, 2nd Place, ISMRM 2025

SNAKE-fMRI: Simulator from Neuro-Activation to K-Space Evaluation.

2025

CDSN Doctoral Fellowship, ENS

Competitive PhD funding awarded to top ENS students.

2021 - 2024

SKILLS

Machine Learning: Deep Learning, Computer Vision, Plug-and-Play Methods, Implicit Neural Representations, Image Denoising, Model Training and Evaluation

Mathematics: Inverse Problems, Convex Optimization, Compressed Sensing, Signal Processing, Scientific Computing, Simulation

Domain: MRI, fMRI, Medical Imaging, Neuroimaging, Image Reconstruction, Ultrasound Tomography

Programming: Python, CUDA, Triton, C++, MATLAB, Bash

Libraries and Tools: PyTorch, JAX, NumPy, CuPy, Pandas, scikit-learn, Git, Docker, Singularity, Slurm, HPC, pytest, Sphinx

Languages: English (Fluent), French (Native), German (Fluent)