Personal data

Research and Teaching SNSF Fellow
Head of the Axon Lab, Dept. Radiology, CHUV

sipSQH8AAAAJ (Google Scholar)
0000-0001-8435-6191 (ORCID)

Education

Ph.D. Electronic Engineering · Universidad Politécnica de Madrid (Madrid, Spain) **Nov 25, 2015**
Thesis doi:10.20868/UPM.thesis.38431.

M.Eng. Electronic Systems · Universidad Politécnica de Madrid (Madrid, Spain) **Sep 2010**

M.Eng. Telecommunications · Universidad Politécnica de Madrid (Madrid, Spain) **Sep 2009**

Past and present positions

Research and Teaching SNSF Fellow (100%) **Jun 2020 → Currently**
Dept. of Radiology, Lausanne University Hospital (CHUV) and University of Lausanne (UNIL)
Uncovering the interplay of structure, function, and dynamics of brain connectivity using MRI · Functional and diffusion MRI (f/dMRI) · Reliability of networks extracted from fMRI · Image quality · Data privacy protection · Preclinical imaging · Infant imaging · Templates and atlases

Neuroimaging Contractor · Independent consulting services (5%) **Nov 2018 → Nov 2024**
Consulting for Darmiyan Inc., 1 Sansome Street, Suite 3500, San Francisco, CA 94104, USA - Advising with neuroimaging analysis with focus on template and atlas knowledge · NumFOCUS / CZI EOSS3-0000000224 (PI: Brett) - Development of the neuroimaging NiBabel library (NiTransforms project) · University of Texas at Austin (UT), NIMH R01MH126699 (PI: Pestilli) - Development of BIDS Derivatives for Network Analyses.

Postdoctoral Fellow (100%) · Dept. Psychology, Stanford University (CA, USA) **Nov 2015 → May 2020**
Reproducibility of biomedical image analysis, data sharing (OpenNeuro) and data aggregation/engineering, machine learning, computational and data sciences infrastructure, HPC, HTC, cloud computing for signal processing, MRIQC, fMRIPrep, TemplateFlow, NiPreps, scientific data structures (e.g., BIDS), BIDS-Apps. Supervised by **Prof. Poldrack**.

Developer and Systems Administrator (60%-80%) **Sep 2004 → Jun 2008**
MP2P Technologies SA (Madrid, Spain)
Development of responsive web user interfaces · Distributed data storage · P2P algorithms · Internet services.
Supervised by Mr. **P. Soto (CEO / Owner)**

Research funding and grants

US CZI EOSS5-0000000266 · PI · $325'000.– **Nov 2022 → Oct 2024**
NiPreps - A Community Framework for Reproducible Neuroimaging

SNSF Ambizione 185872 · PI · CHF 950'155.– **Jun 2020 → Dec 2024**
Uncovering the interplay of structure, function, and dynamics of brain connectivity using MRI

US NIMH RF1MH121867 · Co-PI · $1'445'753.– **Jul 2021 → Jul 2024**
NIPreps: integrating neuroimaging preprocessing workflows across modalities, populations, and species

US CZI EOSS3-0000000224 · Co-PI · $392'000.– **Jun 2021 → Apr 2024**
NiBabel - Open source to change the culture of science

Academic age

11yr since first publication · 8.75yr since Ph.D. Thesis

Child **May 2021 → Jun 2021**
Child **Jan 2018 → Mar 2018**

Honors and awards

Junior Lecturer Award **Jun 2016**
IEEE Summer School on Biomedical Imaging, St. Jacut de la Mer, France
ESKAS Fellowship - Swiss Federal Commission for Foreign Students **Sep 2011 → Sep 2012**
Signal Processing Lab (LTS5), École Polytechnique Fédérale de Lausanne (EPFL)
Master student fellowship · Inst. Salud Carlos III, Spanish Ministry of Health **Oct 2008 → Sep 2009**
Biomedical Image Technologies (BIT), Universidad Politécnica de Madrid (UPM)

Professional development and other training

The Four Steps to Grant Funding · Marketing Your Science, LLC & CZI · 24h **Apr 2024**
Equitable Recruiting and Hiring · La Cire & CZI · 8h **Feb 2024**
DEI Leadership essentials course · Université de Lausanne · 40h **Aug 2023**
Take charge of your time: the power of a Positive NO · Université de Lausanne · 4h **Apr 2023**

Continuing education

Visiting Graduate Researcher · Dept. of Mathematics, UCLA, CA, US **Sep → Nov 2013**
EU Erasmus faculty's mobility program, 1st IEEE SPS Summer School on Biomedical Image Processing and Analysis, Dubrovnik, (Croatia) **Jun 8-14, 2013**
10th IEEE EMBS International Summer School on Biomedical Imaging, Berder (France) **Jun 21-30, 2012**
Visiting Graduate Researcher · Dept. of Mathematics, UCLA, CA, US **Oct → Dec 2012**
ATHENS student's mobility program, Building Energy Simulation course, Technische Universität München, Lehrstuhl für Bauinformatik, Munich (Germany) **Nov 16-24, 2007**

Language skills

English (C2) | **French** (B2.2) | **Spanish** (mother tongue)

Suggested references

- Prof. **Jean-Philippe Thiran**, EPFL <JP.Thiran@epfl.ch>
- Prof. **Russell A. Poldrack**, Stanford University, <poldrack@stanford.edu>
- **Meritxell Bach-Cuadra**, M.E.R., CHUV and UNIL, <Meritxell.BachCuadra@unil.ch>
- **Marie Schaer**, Ph.D., HUG and UNIGE, <Marie.Schaer@unige.ch>
- Prof. **Benedetta Franceschiello**, HES-SO Valais-Wallis, <benedetta.franceschiello@hevs.ch>
- **Satrajit S. Ghosh**, Ph.D., MIT, <satra@mit.edu>
- **Krzysztof J. Gorgolewski**, Ph.D., Anthropic, <krzysztof.gorgolewski@gmail.com>
- **Elda Fischi**, Ph.D., EPFL, <elda.fischi@epfl.ch>
- Prof. **Patric Hagmann**, CHUV, <patric.hagmann@chuv.ch>
- **Martin Nørgaard**, Ph.D., University of Copenhagen, <noergaard@stanford.edu>
- **Ariel Rokem**, Ph.D., University of Washington, <arokem@uw.edu>
- **Franco Pestilli**, Ph.D., University of Texas at Austin, <pestilli@utexas.edu>

■ Self-evaluation

I am a **computational neuroscientist** and **open science advocate** specializing in developing standardized neuroimaging workflows to advance clinical decision-making and translational research. My work consistently integrates neuroimaging techniques with clinical and biological data, bridging the gap between scientific research and practical applications in healthcare. As the leader of the *NeuroImaging PREProcessing toolS* (*NiPreps*) community, I oversee the development of key tools such as *fMRIPrep*, which has signified a paradigm switch in how computational neuroscience is approached within neuroimaging. With over 700 citations a year and 30'000 successful executions a week, *fMRIPrep* has demonstrably enabled a substantial volume of fMRI research for the last five years, and its user base continues to grow steadily. My efforts are focused on ensuring these pipelines are scientifically **rigorous, reliable, transparent, and scalable**, making them accessible to a broad spectrum of users, from clinicians to data scientists.

Through my work after founding the *Axon Lab*, I lead initiatives such as the *Human Connectome Phantom* (HCPh) project, which will improve the reliability and reproducibility of **neuroimaging-derived brain networks**. These advancements are vital for **bridging clinical needs** with innovative technical solutions. This interest in reliability and reproducibility is complemented by my extensive work in the definition, implementation, and advocacy for integrating robust **QA/QC protocols** within the neuroimaging workflow. Related interests cover the relevance of **data stewardship**, the conviction that **data-sharing** enables more transparent and reproducible research and the promotion of **best practices** for protecting and managing personal health information and participants' privacy. I have actively contributed to and advocated for open science practices, which are reflected in the open-source projects I lead and contribute to, such as *MRIQC*, *NiBabel*, and others. My work has been funded by prestigious organizations, including the *National Institutes of Health* (*NIH*), the *Chan Zuckerberg Initiative* (*CZI*), and the SNSF. In addition to these technical advancements, I have cultivated collaborations across leading research institutions such as UniGE, EPFL, and CHUV and international partners like Stanford, MIT, and UPenn, supporting my readiness to drive collaborative, large-scale research.

My endeavors have set new standards for research robustness. As described in my 'Scientific planning' statement below, I intend to continue doing so by spearheading the integration of cutting-edge computational methods with clinical and biological data. These will enable a **better understanding of the brain**, define **comparative analyses and normative models** that support new applications for early diagnosis, establish **homologies between populations and species**, **predict disease trajectories,** and **optimize clinical interventions**. These are keystones of the vision of AI for personalized health.

■ Research outputs

Top-5 publications

Esteban, O., … Gorgolewski, K. J. (2019). *fMRIPrep: A robust preprocessing pipeline for functional MRI*. **Nature Methods**, 16(1), 111–116. **(2019) 3056 citations**
doi:10.1038/s41592-018-0235-4 (OA pre-print)
The paper describes *fMRIPrep*, a game-changing software tool to automate and standardize the preprocessing of functional magnetic resonance imaging (fMRI) data. *fMRIPrep*'s standardization improves the reliability and interpretability of fMRI studies and bolsters the consistency of the neuroimaging workflow across labs by reducing methodological variability. The tool and this paper have had a transformative impact on the field.

Esteban, O., … Gorgolewski, K. J. (2017). *MRIQC: Advancing the automatic prediction of image quality in MRI from unseen sites*. **PLOS ONE**, 12(9), e0184661. **(2017) 874 citations**
doi:10.1371/journal.pone.0184661 (OA)
MRIQC addresses a critical challenge in large-scale neuroimaging studies —ensuring data quality. Traditionally, quality control (QC) relies on subjective visual inspection, which is time-consuming, prone to errors, and less feasible for massive datasets. This paper introduces MRIQC, an automated tool that uses quantitative metrics to assess the quality of T1-weighted brain MRI scans. Unlike previous efforts, MRIQC is specifically designed to

generalize across different scanning sites, a crucial capability for large-scale, multi-site studies that have become increasingly popular.

Ciric, R., … **Esteban, O.** (2022). *TemplateFlow: FAIR-sharing of multi-scale, multi-species brain models*. **Nature Methods**, 19, 1568-1571. doi:10.1038/s41592-022-01681-2 (OA) **(2022) 70 citations**
This paper introduces *TemplateFlow*, a tool that facilitates the sharing of brain models across different scales and species. The paper shows how sharing these models has been challenging due to their complexity and diversity. *TemplateFlow* addresses this by providing a standardized format based on BIDS (Brain Imaging Data Structure) and a platform for storing and accessing these models, promoting open science and collaboration within the neuroscience community.

Provins, C., … **Esteban, O.** (2023). *Reliability characterization of MRI measurements for analyses of brain networks on a human phantom*. **Nature Methods** (Registered Report Stage 1 Accepted In Principle). doi:10.6084/m9.figshare.19579873.v1 (OA) **(2023) 5 citations**
This Registered Report (RR) investigates the reliability of MRI measurements for brain network analysis using a human phantom. RRs are a type of publication where the methodology is reviewed and confirmed before data collection, promoting transparency and reducing bias. This Stage 1 RR is a valuable tool for improving research rigor and reproducibility in neuroscience and will contribute with a unique open dataset to the field.

Markiewicz, C. J., … Poldrack, R. (2021). *The OpenNeuro resource for sharing of neuroscience data*. **eLife**, 10, e71774. doi:10.7554/eLife.71774. (OA) **(2021) 303 citations**
OpenNeuro is a foundational online platform for sharing neuroscience data. Traditionally, sharing such data was cumbersome and inconsistent, hindering collaboration and progress in the field. OpenNeuro provides a centralized, open-access repository designed explicitly for neuroscience data, allowing researchers to easily share, find, and reuse data, accelerating scientific discovery and innovation. This fosters open science practices and collaboration within the neuroscience community.

** Citation numbers retrieved from Google Scholar on March 7, 2024.

Methods, tools, infrastructures, data, etc.

NeuroImaging PREProcessing toolS (*NiPreps*) · www.nipreps.org · github.com/nipreps **2021 → Currently**
NiPreps is a suite of open-source tools that streamlines the preprocessing of neuroimaging data, and a community of researchers from several institutions maintains it. *NiPreps* automates various steps traditionally done with customized tools, saving researchers time and ensuring consistency. *NiPreps* goes beyond its flagship tool, *fMRIPrep*, by offering applications for diverse modalities like structural MRI and diffusion MRI that generalize across species (e.g., rodents or nonhuman primates) and cohorts (e.g., elderly, developing, etc.).

The Human Connectome PHantom (HCPh) dataset and SOPs · axonlab.org/hcph-sops **2022 → Currently**
The *Human Connectome PHantom (HCPh)* is a standardized and highly controlled dataset designed to improve the reliability and accuracy of MRI network analysis. It serves as a benchmark for researchers to compare and validate their processing pipelines. The project also provides openly accessible standard operating procedures (SOPs; axonlab.org/hcph-sops), outlining the rigorous acquisition protocol and ensuring consistent data collection across MRI scanners. This combination of a well-defined dataset and standardized procedures fosters reproducible and comparable research in the field of connectomics.

TemplateFlow · www.templateflow.org · github.com/templateflow **2020 → Currently**
TemplateFlow is a web-based platform that fosters open access and collaboration in the field of neuroscience by providing a standardized framework for sharing brain models. It addresses the challenge of diverse and complex brain models by offering a centralized repository that adheres to the FAIR principles (Findable, Accessible, Interoperable, Reusable). This enables researchers to easily share, discover, and reuse brain models across multiple scales and species. By facilitating collaboration and promoting the development of standardized brain models, *TemplateFlow* paves the way for a deeper understanding of the brain and advancements in various fields relying on brain modeling. Featured at Nature Methods: *Harnessing the multiverse of neuroimaging standard references*. Nat Meth 19, 1526–1527 (2022). doi:10.1038/s41592-022-01682-1.

The Brain Imaging Data Structure (BIDS) · bids.neuroimaging.io **2016 → Currently**
BIDS is a widely adopted standardized format for organizing and describing neuroimaging data. This ensures data consistency across studies, facilitating sharing and analysis. Building upon *BIDS*, *BIDS-Apps* are pre-configured software containers specifically designed to automate analysis pipelines on *BIDS*-formatted data. These

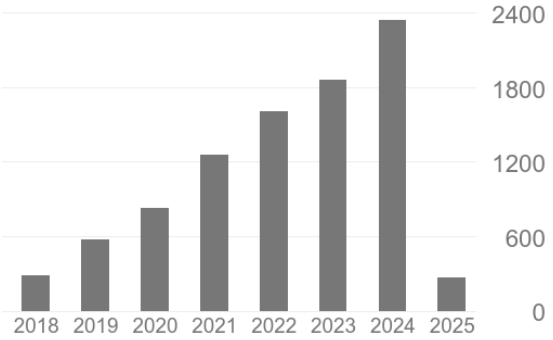
containerized applications offer reproducible and user-friendly analysis tools, streamlining the processing of neuroimaging data and fostering efficient and reliable research.

OpenNeuro · openneuro.org **2016 → 2020**
OpenNeuro is a foundational online platform for sharing neuroscience data. Traditionally, sharing such data was cumbersome and inconsistent, hindering collaboration and progress in the field. OpenNeuro provides a centralized, open-access repository designed explicitly for neuroscience data, allowing researchers to easily share, find, and reuse data, accelerating scientific discovery and innovation. This fosters open science practices and collaboration within the neuroscience community.

Publication indicators

	All	Since 2019
Citations	9653	8214
h-index	24	23
i10-index	34	31

** Citation numbers retrieved from Google Scholar on Feb 6, 2025.



■ Scientific planning

My research naturally blends within IDIAP's *AI for Life* program by advancing the application of **graph signal processing** and **artificial intelligence** techniques to understand brain function and structure (see Figure 1 about our previous work in electrical stimulation of epilepsy patients). A key focus will be developing **latent diffusion models** to map high-dimensional neuroimaging data into lower-dimensional representations that allow efficient **diffusion** and **causal modeling**. Such a framework is necessary to simulate brain anatomy and function conditioned by factors, providing a foundational tool for generating **digital twins**. By simulating plausible disease trajectories, exploring brain homologies across species and developmental stages, and designing counterfactual scenarios, these models will support comparative studies and normative modeling to advance early detection methods in neuroscience. Further research will investigate **multi-modal data prediction and integration**—including the fusion of imaging modalities like MRI, EEG, and fMRI—and the fusion of other sources of information such as physiological signals and genomic or transcriptomic data. Additionally, I plan to apply **quality enhancement** and **temporal super-resolution** by integrating complementary data modalities to reduce costs, minimize patient burden, and increase the reliability of neuroimaging applications. Overall, these advances will minimize healthcare costs and patient burden, making the research cutting-edge and highly applicable in clinical settings.

I plan multiple opportunities for impactful collaboration to foster cross-disciplinary synergy and support high-impact, data-driven discoveries within the IDIAP. Dr. **Raphaëlle Luisier**'s expertise in bioinformatics and computational genomics integrating neuroimaging toward precision medicine applications. A collaboration with Dr. **André Anjos**, with his work in machine learning and computer vision, will allow us to integrate healthcare data into our models, pushing the boundaries of image-driven diagnosis and treatment planning. Dr. **Ina Kodrasi**'s research in signal processing for healthcare, particularly with graph signal processing and the integration of physiological data in denoising and quality enhancement, aligns well with my interests in integrating multi-modal healthcare data. Additionally, Dr. **André Freitas**' work in explainable AI will support the development of models that provide interpretable insights, fostering better clinical decision-making. Additionally, I am excited about coordinating efforts with Prof. **Michael Liebling** to address complex computational problems and potential real-time applications, particularly in image analysis and computational healthcare. Finally, I can anticipate targeted and interdisciplinary collaborations with researchers like Prof. **Sébastien Marcel** and Dr. **Damien Teney** in areas such as privacy protection and explainable AI.

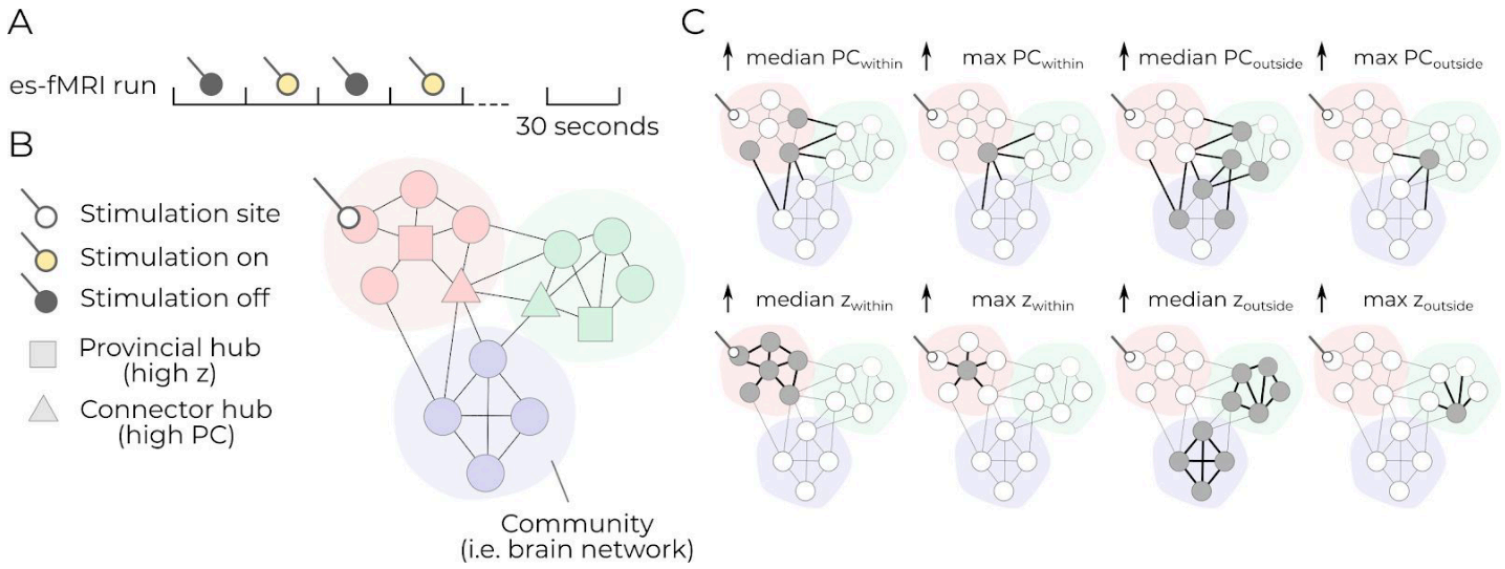


Figure 1. Functional network changes driven by targeted electrical stimulation in epilepsy patients using es-fMRI. *(A) An es-fMRI run involves alternating stimulation on and off periods. (B) Stimulation sites are mapped to specific brain network nodes, where key hubs—provincial (high z-score) and connector (high participation coefficient, PC)—are identified within and across network communities. (C) Graph-theoretic metrics reveal stimulation-induced changes in network properties, including within-community and between-community connectivity. This framework enables quantification of brain network modulation by electrical stimulation, providing foundational insights for developing personalized neuromodulatory interventions and adaptive digital twin models.*

Externally, I aim to continue collaborating with key partners within the Swiss academic landscape. Dr. **Meritxell Bach-Cuadra** (M.E.R., Unil, and CHUV) and my team will continue to jointly explore quality assessment and control and super-resolution techniques in adult and infant populations. Collaborating with Prof. **Serge Vulliemoz** (UniGE), we will focus on advancing computational models for brain network analyses in epilepsy research, furthering the integration of imaging and clinical data. Prof. **Dimitri Van de Ville**'s work at UniGE/EPFL on signal processing for brain imaging and Dr. **Valentina Borghesani**'s research in cognitive functions and brain dynamics at UniGE will enhance our efforts in understanding and modeling brain networks. Additionally, working closely with Prof. **Benedetta Franceschiello** (HES-SO, Sion), we aim to optimize research and clinical neuroimaging protocols that leverage AI in image reconstruction and quality assurance, enabling emergent applications such as low-field MRI. These collaborations will bring computational tools to clinical applications and foster translational research.

Internationally, I plan to maintain collaborations with esteemed colleagues such as Prof. **Russell Poldrack** (Stanford University), Dr. **Satrajit Ghosh** (MIT), Prof. **Theodore Satterthwaite** (UPenn), Dr. **Ariel Rokem** (University of Washington), Prof. **Pierre Bellec** (Montreal University), Dr. **Martin Nørgaard** (University of Copenhagen), and Dr. **Diana Cash** (Brain Centre, KCL). These international connections will amplify IDIAP's global visibility, driving forward collaborative projects and enabling cutting-edge research on a larger scale.

Beyond the immediate research impact, my work will enhance IDIAP's international standing in several key areas, mainly through my leadership in open science initiatives like *NiPreps* and *Brain Imaging Data Structure* (*BIDS*). I have consistently contributed to global efforts promoting standardization and reproducibility in computational sciences, which has forged strong connections with international consortia and large-scale collaborative projects. My open-source tools, such as *fMRIPrep* and *MRIQC*, have been highly cited and published in top-tier journals like *Nature Methods*, establishing a solid foundation for IDIAP to become a hub for reproducible machine learning applications in healthcare.

In addition to my contributions to open science, I have a proven track record of **securing significant external funding** from various prestigious sources across multiple countries. My funding portfolio includes grants from the U.S. National Institute of Mental Health (NIMH), supporting neuroimaging techniques for both clinical and research applications. Moreover, I have received funding from the Chan Zuckerberg Initiative (CZI) under their Essential Open

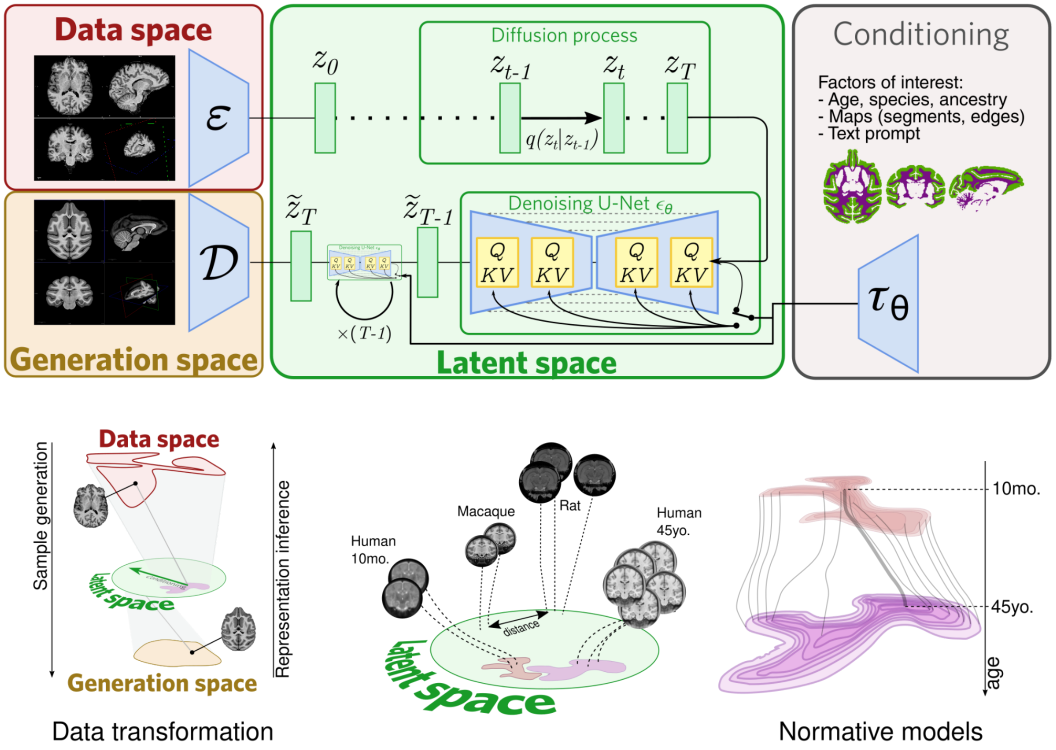


Figure 2. A framework for projecting neuroimaging into a lower-dimensional latent space. *The proposed framework adapts the latent diffusion model proposed by Rombach and colleagues to encode high-dimensional neuroimaging data into a lower-dimensional latent space while preserving essential features. This reduces complexity, enabling efficient, interpretable analyses. Features in the latent space can be mapped across modalities (e.g., aligning fMRI and EEG for temporal enhancement), manipulated (e.g., forecasting developmental trajectories), or used to establish normative models for identifying pathological deviations. This flexible framework supports multimodal integration, graph-based brain network modeling, and cross-species comparisons between human and non-human primate brains. The flowchart at the top has been adapted from Figure 3 of Rombach's work (2022).*

Source Software for Science program, with multiple rounds of support for critical neuroimaging libraries like *NiPreps* and *NiBabel*. Additionally, I have secured competitive Swiss National Science Foundation (SNSF) funding through the Ambizione grant. These accomplishments demonstrate my ability to build sustainable and interdisciplinary research programs. By nurturing a solid publication strategy focused on impactful translational research and technical innovations, I aim to strengthen IDIAP's visibility at international conferences, workshops, and leading journals, ensuring our collaborative research efforts reach a global audience.

Through these efforts, I will meaningfully contribute to positioning IDIAP as a global leader in AI for healthcare, cementing its reputation within academic and applied research communities. My active involvement in international open science consortia and the wide dissemination of research tools will facilitate visibility and promote long-term collaborations, ensuring IDIAP remains at the forefront of AI-driven healthcare solutions.

■ Technology Transfer and Industry Impact

fMRIPrep · Preprocessing of functional MRI data · Open Source Software (employed by numerous companies and hospitals)
MRIQC · Quality Assurance and control (QA/QC) of structural, functional, and diffusion MRI data · Open Source Software (employed by numerous companies and hospitals)
QuantiDOPA · Software for the quantification of dopaminergic receptors with PET · Qubiotech Health Intelligence, S.L., A Coruña, Spain
FocusDET · Software for the location of epileptic foci for surgery planning in pharmacoresistant cases · Qubiotech Health Intelligence, S.L., A Coruña, Spain

■ Research collaborations

***NiPreps* Community & BIDS** **2016 → Currently**
I created and am part of the first *NiPreps Steering Committee* that drives *NiPreps*. The *NiPreps Community* is a global assembly of researchers that supports an open-source generalizable-neuroimaging ecosystem. I have driven the organization of the community and its Governance (https://github.com/nipreps/GOVERNANCE), secured the necessary funding, and this collaboration continues to produce impactful neuroimaging software (*fMRIPrep*, *MRIQC*, *dMRIPrep*, *TemplateFlow*, etc.). I am a longstanding member of BIDS, an international consortium that aims to standardize the organization and description of neuroimaging data. I have contributed to the development and maintenance of the BIDS specification and the BIDS Apps.

NMIND (*Nevermind, this Method Is Not Duplicated*) **2018 → Currently**
I am a founding member of NMIND, a collaborative network of researchers that seeks to improve the reproducibility and transparency of neuroimaging methods. I have participated in the creation and dissemination of the NMIND principles and the NMIND website.
Kiar, G., Clucas, J., Feczko, E. et al. Align with the NMIND consortium for better neuroimaging. Nat Hum Behav 7, 1027–1028 (2023). doi:10.1038/s41562-023-01647-0.

OHBM-OSIG & BrainHack **2016 → Currently**
I am an active member of the OHBM-OSIG, the Open Science Interest Group of the Organization for the Human Brain Mapping. This group promotes open science practices and resources in the neuroimaging community. I have organized and attended several events and workshops related to the OHBM-OSIG. I am a part of the BrainHack community, a global network of researchers that organizes hackathons and other events to foster collaboration and innovation in neuroscience. I have hosted and joined several BrainHack events.

NiPy **2012 → Currently**
I have been a lead developer of *NiPype*, a *Python* library that provides a uniform interface to existing neuroimaging software. I actively contribute to *NiBabel*, a *Python* package that can read and write common neuroimaging file formats. I lead *NiBabel*'s subproject *NiTransforms*, a *Python* library that implements spatial transforms for neuroimaging data. *NiPy* is a community of practice that uses *Python* to analyze neuroimaging data. It supports various projects for different types of neuroimaging data, such as diffusion MRI, functional MRI, and more.

Lemanic neuroimaging connectomics **2020 → Currently**
My *Ambizione* project laid the groundwork to establish a collaboration on the reliability of connectivity analyses across several institutions in the Lemanic arc: CHUV, CIBM/EPFL, HUG.

■ Research supervision and mentoring

Research Group

The Axon Lab is a small research group of four members: myself, one postdoctoral engineer, one PhD student, and one research assistant. We are based at the Department of Radiology of the Centre Hospitalier Universitaire Vaudoise (CHUV) in Laussane (Switzerland), within the Faculté de biologie et de médecine of University of Lausanne (UNIL). As the group leader, I oversee the overall direction and vision of the group, as well as the supervision and mentoring of the junior researchers. I also actively participate in the research projects' design, implementation, and dissemination. The group's main research interests are graph signal processing and artificial intelligence applied to neuroimaging data, such as structural and functional MRI, diffusion MRI, and electroencephalography. We aim to develop novel methods and tools for analyzing high-dimensional neuroimaging data to translate them to clinical applications and improve the understanding of the brain. The group's website is https://www.axonlab.org, where a description of the people involved and our Code of Conduct and DEI statements are presented.

Advising and mentoring philosophy

Advising and mentoring Master's and Ph.D. students is central to my academic career. I prioritize creating an inclusive, supportive environment where students feel empowered to express their ideas while receiving structured academic and professional development guidance. I encourage students to develop Individual Development Plans

(IDPs), which allow them to track their progress and goals, ensuring they remain flexible and adaptable to emerging opportunities. Regular discussions ensure these plans are effectively tailored to each student's needs and evolving interests.

In my lab, we emphasize scientific transparency and reproducibility. Lab members actively contribute to version-controlled Standard Operating Procedures (SOPs), fostering a collaborative, ethical research culture. In addition, maintaining version-controlled digital lab notebooks is a crucial practice that ensures:

- Proper documentation of all research tasks, including the most clerical or repetitive ones, is essential to the lab's success.
- A seamless handover process when students or researchers transition, preserving knowledge and contributions.
- Transparent project health monitoring ensures progress is aligned with IDPs and fosters informed decision-making based on current data.

One of the key elements in our lab is a collaboratively developed Code of Conduct, which is reviewed annually to maintain its relevance. This code outlines institutional resources and mechanisms to ensure the well-being of all lab members and provides a clear framework for addressing conflicts or inappropriate actions.

In my lab and the broader NiPreps community, we approach authorship and contributions fairly and transparently. Authorship is typically established early in the project and revised as needed, ensuring all contributors are properly credited. Special attention is given to junior researchers, providing them opportunities to lead publications, helping them advance their careers, and recognizing their contributions.

I also promote active engagement with the broader scientific community. PhD students, research assistants, and Master's students are encouraged to take leadership roles in submitting abstracts and posters to conferences, boosting the visibility of their work. I emphasize participation in international communities like NiPreps and BrainHack, which expands their professional networks, increases the impact of their research, and facilitates new collaborations. While budgeting for these activities requires careful grant planning, I view this investment as essential to my students' long-term success.

My commitment to leadership and mentoring has been enhanced through participation in leadership development programs at institutions such as the University of Lausanne (UNIL) and the Chan Zuckerberg Initiative (CZI), which focus on Diversity, Equity, and Inclusion (DEI). These values are integral to my mentoring approach, and I remain dedicated to continued professional development to ensure my mentoring practices align with institutional priorities.

I look forward to bringing these practices to IDIAP, where I can contribute to advancing biomedical data science education. I look forward to mentoring future data scientists and fostering a collaborative and innovative culture where students from diverse backgrounds can thrive. By working across IDIAP's partner institutions and research programs, I will help cultivate the next generation of leaders in AI-driven healthcare solutions.

Mentoring and coaching of junior investigators

Alexandre Cionca, RA (CHUV, Sep 2023 → currently); MSc. Thesis (EPFL & Stanford University, Jan → Jun 2020) · **Elodie Savary**, Postdoctoral Research Engineer (CHUV, Dec 2022 → currently) · **Céline Provins**, Ph.D. Student (UNIL, Jan 2021 → currently) · **Rastko Ciric**, Graduate Student (Stanford University, Sept 2018 → currently) · **Mathias Goncalves**, Junior Research Engineer (Stanford University, June 2019 → currently) · **Sashank Bansal**, Research Assistant (Stanford University, Sept 2019 → April 2022) · **McKenzie P. Hagen**, Research Coordinator (Stanford University, May 2019 → May 2021) · **Eilidh E MacNicol**, Visiting Doctoral Researcher (Stanford University, Jan → May 2020) · **Avinash Kori**, MEng. Thesis (Stanford University & Indian Institute of Technology (IIT) Madras, Jun 2019 → Jul 2019) · **Kevin Liao**, Graduate Student (Stanford University, Sept → Dec 2018) · **Annalisa Di Leva**, MEng. Thesis (UPM and Universita degli Studi di Napoli II, 2014) · **Vicente Pallarés-Picazo**, MEng. Thesis (UPM, 2011) · **Monica Ferrer-Berbegal**, MEng. Thesis (UPM, 2011)

■ Other scientific activities

Active society memberships

Technical Committee Member, IEEE Bio Imaging and Signal Processing | NJ, USA · International Society for Magnetic Resonance in Medicine (ISMRM) | CA, USA · Organization for Human Brain Mapping (OHBM) | MN, USA · Institute of Electrical and Electronics Engineers (IEEE) | NJ, USA · NMIND: Nevermind, this Method Is Not Duplicated (Consortium of neuroimaging laboratories based in the USA) | USA

Reviewer

I review an average of 30 manuscripts a year, covering journal titles such as NeuroImage, Imaging Neuroscience, Human Brain Mapping, IEEE Transactions on Medical Image, Nature Methods, Nature Neuroscience, eLife, NeuroInformatics, Brain Structure and Function, Network Neuroscience, Communications in Biology, Scientific Data, Scientific Reports, Briefings in Bioinformatics, Frontiers in Neuroinformatics, etc.

Congress organization

ISBI 2012 (Barcelona, Spain): Staff Member. NiPreps Hackathons 2022, 2023, 2024, 2025.

Member of advisory boards

NiPreps Steering Committee **Sep 2023 → Currently**

Invited speaker

Neuroimaging Symposium · Göteborgs Universitet, Göteborg, Sweden **Sep 2025**
1st CIBM+fMRIPrep Bootcamp · CIBM CMU-HUG, UNIGE, EPFL, Geneva, Switzerland **Sep 2024**
DIPY Workshop 2024 · *Imaging Data and Transforms* **Mar 2024**
BrainHack Donostia 2023 · *Pre-registering methods-oriented neuroimaging research, why, when, and how?* **Nov 2023**
BrainHack Donostia 2022 · *The NiPreps Community Unconference* **Nov 2022**
BrainHack Donostia 2021 · *Building the NiPreps community* **Nov 2021**
OHBM Open Science Room · Moderator · *Panel "The future of open tools/technologies"* **Jun 2021**
Open and Reproducible Neuroimaging Workshop · University of Oldenburg (Germany) **Nov 2020**
BrainHack Donostia 2020 · *NiPreps* **Nov 2020**
NeuroHackademy 2020 · *NiPreps* **Jul 2020**
Think Open Rovereto Workshop · *Building next-generation preprocessing pipelines* **Jul 2020**
OHBM Open Science Room · Speaker · Emergent Session on "Open Workflows" **Jun 2020**
Coastal Coding ReproNim+Nipype Workshop · University of Florida, FL **Jan 2019**
1st fMRI "No Data Wasted" workshop · University of North Carolina, Chapel Hill **Dec 2017**
Computational Neuroscience NeuroComp17 Workshop · University of Wisconsin, Madison **Sep 2017**

Nipype Workshop · MIT, Boston **Mar 2017**
3rd Brain Imaging Workshop Lausanne · Centre Hospitalier Universitaire Vaudois, Lausanne **Feb 2013**

■ Contributions to Open Science

I am a dedicated advocate for open science and reproducibility in neuroimaging research. Over the years, I have contributed to several major initiatives that promote open science practices, including NiPreps, BIDS, NMIND, OHBM-OSIG, and BrainHack. As a core developer of critical open-source software such as NiBabel, NiPype, NiTransforms, fMRIPrep, and MRIQC, I aim to provide tools that foster transparency, reproducibility, and accessibility for the broader scientific community. My commitment to open science has been reinforced by successfully securing funding from the Chan Zuckerberg Initiative (CZI) Essential Open Source for Science (EOSS) program twice—once for NiBabel and more recently for NiPreps—highlighting the impact and sustainability of these efforts.

I publish all my research results in open-access journals or provide alternative OA preprints to ensure my findings are freely accessible. A critical component of my open science ethos is the use of registered reports to reduce biases and negative incentives in the scientific publication system. This pre-registration process ensures transparency and rigor, and I actively promote this approach as a way to align the scientific process more closely with reproducibility. I have shared key datasets and research materials openly with the community, including the densely-acquired Human Connectome Phantom (HCPh) data and the *TemplateFlow* neuroimaging-templates registry.

My commitment extends beyond software and data sharing; I have actively organized and participated in open science events, including hackathons, workshops, and webinars, that promote collaboration and education. These initiatives are designed to engage both early-career and established researchers, fostering a community that values and practices open science.

■ Teaching experience

Teaching is a driving force in my academic career and is as essential to my research endeavors. It motivates me to stay in academia, ensuring that the knowledge gained through research can be transferred to and expanded upon by future generations. From universities in Madrid, Lausanne, Los Angeles, Stanford, and Germany, my **geographical mobility** has given me a global perspective on teaching and a unique understanding of how different academic environments approach education. This has enabled me to **connect with students from diverse backgrounds**, enriching my teaching practices and adapting them to varied learning styles. My **experiences as a scholar across diverse institutions** have shaped my teaching philosophy, emphasizing the importance of **"learning by doing."**

Hands-on experience is the most effective way to help students internalize and apply complex concepts, particularly in neuroimaging, where practical skills are just as essential as theoretical knowledge. One key example of this teaching philosophy is the **Nipraxis (NeuroImaging in Practice)** course, which I co-developed with **Dr. Matthew Brett** and **Dr. Christopher Markiewicz**, with support from the **Chan-Zuckerberg Initiative**. The course offers an accessible, open-source curriculum in neuroimaging. In 2022 and 2023, *Nipraxis* engaged students from across the globe, providing an interactive, project-based learning environment covering core concepts in **Computer Science**, **Signal Processing**, and **functional MRI analysis**. Its open-access format ensures that students from various institutions and countries can benefit from this resource. Not only in the case of *NiPraxis*, **all my teaching materials are available online and released under a CC-BY license**, ensuring they are freely accessible for anyone to use, modify, and distribute. The materials are written in **Markdown**, maximizing their **accessibility and usability**. This choice not only makes the materials available for a wide audience but also facilitates their adaptability for different contexts, such as **AI agents**, translation, and customizable visualizations. This technology enables the integration of a comprehensive range of **rich media** into the content, enhancing the learning experience. My teaching materials are embedded with interactive elements—whether it's navigating **PDF files**, **websites**, or embedding **videos and figures** supported by HTML. Furthermore, **code examples** are presented using technologies that make them feel like **live demos on video** while maintaining accessibility for students to **copy and paste** seamlessly. This blend of hands-on interactivity and rich media ensures that students are not only passively consuming content but actively engaging with it. In addition, I also profusely use **Jupyter Notebooks** and **Linux Containers** to provide an interactive environment where students can actively engage with the content, making theoretical knowledge come to life through hands-on coding and experimentation.

The **NiPreps** framework has given rise to a new line of neuroimaging training initiatives. I organized the first **CIBM + fMRIPrep BootCamp** at the **University of Geneva** in September 2024, which focused on hands-on training for fMRI preprocessing using NiPreps tools. The BootCamp was a resounding success, and future editions are already in the planning stages at other neuroimaging centers, including **The Edmond and Lily Safra Center for Brain Sciences** at **The Hebrew University of Jerusalem**. These bootcamps, designed to provide a robust foundation in neuroimaging techniques, emphasize reproducibility, transparency, and the open science practices that NiPreps promotes. I also take great pride in organizing smaller, focused workshops and seminars. I have participated in events like **BrainHack** and workshops by the **Organization for Human Brain Mapping (OHBM)**, ensuring that students and researchers across the globe can access valuable learning opportunities tailored to their needs.

My teaching approach will bolster IDIAP's multidisciplinary, multi-institutional research programs, ensuring that my courses provide core technical knowledge and facilitate cross-disciplinary learning between AI, computational biology, and healthcare applications. Given the **institute's partnerships with EPFL, UniGE, UNIL, and others**, I will focus on creating educational programs that benefit from IDIAP's unique position in Switzerland's research ecosystem. These programs will address the needs of researchers from different domains and institutions, encouraging collaborations that reflect IDIAP's role as a hub for AI-driven innovation across multiple fields. To these ends, my experience with developing accessible open-source materials will enhance IDIAP's mission to disseminate knowledge globally. By supporting students at various institutions and making all teaching materials openly available, I will contribute to expanding the reach and impact of IDIAP's educational efforts.

Highlighted teaching experiences

> ***NeuroImaging in Practice (NiPraxis)* course** · nipraxis.org **2021 → Currently**
> I participated in the design and development of *NiPraxis*, a hands-on course that teaches the principles of functional MRI (fMRI) data analysis using open-source software and tools (textbook: textbook.nipraxis.org). The course covers topics such as data acquisition, preprocessing, modeling, quality control, and reproducibility. The course also integrates my research on network neuroscience and graph signal processing, as well as the latest

developments and challenges in the field. We offered *NiPraxis* course as part of the Lemanic Neuroscience Doctoral School (LNDS). The course attracted students from different backgrounds and disciplines, and received positive feedback and evaluations. The course also fostered collaboration and exchange among students and instructors, as well as with other researchers and stakeholders in the neuroimaging community.

Non-formal education (workshops, hackathons, seminars, etc.) **2016 → Currently**
I frequently teach in workshops and hackathons, where I can share my knowledge and skills in neuroimaging data analysis with diverse and interdisciplinary audiences. I have participated in several events organized by the BrainHack community, the OHBM-OSIG, NeuroHackademy, and other initiatives. I have also given lectures and tutorials on various topics around MRI reliability, reproducibility and open science. I have taught at the 2024 DIPY workshop (https://workshop.dipy.org/), an online event that teaches the latest techniques and tools in structural and diffusion imaging and will soon lead the first fMRIPrep CIBM BootCamp (September 9-11, 2024, Campus Biotech, Geneva, https://cibm.ch/event/fmriprep-bootcamp/).

Introduction to image processing in ITK · MEng. Biomedical Engineering, UPM **2009 → 2011**
The course aimed to introduce the basics of image processing using the Insight Toolkit (ITK), an open-source, object-oriented software system for image analysis. The course covered topics such as image representation, filtering, segmentation, registration, and visualization. The course was eminently practical through exercises and examples using ITK and Python. The course was intended for students and researchers who wanted to learn how to use ITK for their own image-processing projects or applications. The course was based on the ITK Software Guide and the ITK documentation, as well as other relevant sources and materials. The course was well-received by the participants, who gained valuable skills and knowledge in image processing and ITK.

■ Development of teaching tools and activities

1st CIBM fMRIPrep bootcamp · CMU, UniGE, Geneva 10-12 September 2024 **2024**
Three-day workshop and *hackathon* organized with the support of CIBM EPFL

***NeuroImaging in Practice (NiPraxis)* course** · nipraxis.org **2021 → 2023**
The teaching materials and delivery of the course were collaborative and funded by the Chan-Zuckerberg foundation (US CZI EOSS3-0000000224, described in section Research).

Jupyter Notebooks and collaborative online e-books **2016 → Currently**
One of the goals of my research is to disseminate and share the methods and tools that I develop for neuroimaging data analysis, such as *NiPreps* and *NiTransforms*. To achieve this, I use *Jupyter Notebooks* and collaborative online e-books as platforms for creating interactive and reproducible tutorials and documentation employing open data. Some examples of Jupyter Notebooks and collaborative online e-books that I have created or contributed to are:
(i) The QC-Book (nipreps.org/qc-book), a collaborative, online e-book that teaches the principles and practices of quality control (QC) for neuroimaging data. It covers topics such as QC metrics, visual inspection, automated QC, and reporting. The QC-Book is based on the *MRIQC* tool, which is part of the *NiPreps* ecosystem.
(ii) The *NiPreps book* (nipreps.org/nipreps-book) provides an introduction and overview of the *NiPreps* framework, its projects, and its community. It also includes tutorials and examples on how to use *NiPreps* tools for different types of neuroimaging data, such as fMRI, dMRI, and sMRI.
(iii) The *NiTransforms* tutorial (nitransforms.readthedocs.io/en/latest/examples.html): Jupyter Notebooks that demonstrate how to use *NiTransforms*, a Python library that implements spatial transforms for neuroimaging data. It shows how to create, apply, and manipulate different types of transforms, such as affine, nonlinear, and composite transforms.
These materials are supported by US NIMH RF1MH121867 and US CZI EOSS5-0000000266 (described in section Research). They are also open-source and open-science resources that anyone can access, use, and contribute to. They are designed to facilitate the learning and adoption of *NiPreps* and *NiTransforms*, as well as to promote the reproducibility and transparency of neuroimaging data analysis.

Design of HES-SO Course on High-Performance Computing and Distributed AI **2024**
Example of an introductory 15-minute lecture and program for a Bachelor course for 15 students, over 16 weeks with four 45-min lectures per week: https://oesteban.github.io/talks/teaching-20240208

■ Management skills

As a team and project leader, I follow three main principles: leading by example, empowering my team members, and fostering a collaborative and transparent culture. I demonstrate these principles in various ways, such as:

- **Hiring and inclusivity**: I consider hiring as a crucial managerial responsibility, and I conduct it with care and inclusivity. I seek the opinion of third parties and collaborators, including the HR unit of the institution, and I ensure that the hiring process is accessible to diverse candidates. Recently, I took a CZI course offered to CZI grantees, "Equitable Recruiting and Hiring," by Lauren Bell on January 2, 2024.
- **Leadership development**: I recognize the importance of leadership in research, and I constantly seek to improve my skills and knowledge. In August 2023, I finished a UNIL FBM course for group leaders called "Leadership Essentials" https://www.unil.ch/fbm/fr/home/menuinst/la-releve-academique/egalite,-diversite-et-inclusion/leadership-courses-ssf.html, where I learned about effective communication, feedback, and conflict management. I coincided in this course with Prof. Jean Louis Raisaro.
- **Communication and transparency**: I use version control in all source code implementations, and I make extensive use of code managerial tools and automations (e.g., GitHub) for fostering transparent and fluent communication among stakeholders (e.g., through GitHub issues and GitHub projects). I also use GitHub to share internal and public documentation (e.g., https://axonlab.org/hcph-sops), where I document the standard operating procedures and best practices of my research group.
- **Empowering Team Members**: I actively encourage my team members' personal and professional growth by utilizing Individual Development Plans (IDPs). These IDPs are live documents under version control, allowing for ongoing feedback and adjustment of expectations. They facilitate communication between mentor and mentee, fostering a growth environment while ensuring alignment with both personal goals and team objectives.

In leading large-scale projects, particularly in data science, I ensure that workflows are optimized for collaboration, especially when handling complex, multi-modal datasets such as genomics and clinical information. I look forward to implementing these strategies at IDIAP, where I can contribute to advancing AI-driven research programs and fostering a vibrant, inclusive research environment.

■ Institutional involvement

***Code and Data Monthly (CDM)* seminar** **Jan 23 → Jun 24**
I organize a monthly seminar on Open Science, Computational Neuroscience, and Medical Imaging Engineering for the Department of Radiology of CHUV.

Friday Radiology Research Interdisciplinary Meeting **2020 → Currently**
I attend this weekly seminar organized by the Department of Radiology of CHUV, in which medical staff and research staff exchange their ideas and build new projects.

Contributing to the research, teaching, or service activities of the LNDS **2020 → Currently**

Providing feedback, suggestions, or ideas to improve the quality and effectiveness **2020 → Currently**