

Jean Feydy

Research fellow at Inria Paris

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Citizenship : French

Date of birth: June 4th, 1994

Research interests

I focus on geometric data analysis, with applications to medical sciences.

I develop fast software libraries for kernel methods, optimal transport and 3D shape analysis.

Education and employment

- since 2021 **Research fellow (Chargé de Recherche), Inria Paris.**
In the HeKA team, with a focus on public health and computational anatomy.
- 2019–2021 **Post-Doctoral research, Imperial College London.**
In the department of computing, under the supervision of Michael Bronstein.
- 2016–2019 **PhD in applied mathematics, École Normale Supérieure de Cachan.**
“Geometric data analysis, beyond convolutions”, under the supervision of Alain Trouvé.
- 2015–2016 **Pre-doctoral internship, École Normale Supérieure de Cachan.**
Under the supervision of Alain Trouvé.
- Ap.-Sep. 2015 **MVA internship, Siemens Healthcare, Princeton, NJ,** design of a real-time denoising pipeline using structure tensors and steerable wavelets.
- 2014–2015 **Student at the M2 MVA, "Mathematics, Vision, Learning", École Normale Supérieure de Cachan,** graduated with highest honours.
- 2012–2016 **Student at the École Normale Supérieure (Paris), Major in Mathematics.**
- 2010–2012 **2-year intensive program preparing for the national competitive exam for entry to engineering schools, Lycée Marcelin Berthelot, Saint-Maur-des-Fossés.**

Software

- since 2024 **Scikit-shapes**, *an accessible toolbox for statistical shape analysis: scikit-shapes.github.io*, under construction.
- since 2021 **SurvivalGPU**, *a scalable implementation of the standard survival and WCE packages for the analysis of drug consumption data: github.com/jeanfeydy/survivalGPU*.
- since 2019 **GeomLoss: geometric loss functions for shape processing and data analysis**, *a PyTorch package for the computation of kernel norms, chamfer distances and optimal transport costs that scales up to millions of samples in seconds: www.kernel-operations.io/geomloss*, downloaded 200k times.

since 2018 **KeOps: kernel operations on the GPU, with autodiff, without memory overflows**, a library that provides efficient support for semi-symbolic (“distance-like”) matrices on CPUs and GPUs. Implemented in CUDA/C++ with PyTorch, NumPy, R and Matlab bindings: www.kernel-operations.io, developed with Benjamin Charlier and Joan Glaunès, downloaded 650k times.

Publications (* denotes co-first authorship)

- Preprints **An optimal transport model for dynamical shapes, collective motion and cellular aggregates**, ArXiv:2402.17086, Antoine Diez, Jean Feydy.
- Approximation and structured prediction with sparse Wasserstein barycenters**, ArXiv:2302.05356, Minh-Hieu Do, Jean Feydy, Olga Mula.
- Sinkhorn divergences for unbalanced Optimal Transport**, ArXiv:1910.12958, Thibault Séjourné, Jean Feydy, François-Xavier Vialard, Alain Trouvé, Gabriel Peyré.
- 2024 **Anisotropic power diagrams for polycrystal modelling: efficient generation of curved grains via optimal transport**, *Computational Materials Science*, Maciej Buze, Jean Feydy, Steven M. Roper, Karo Sedighiani, David P. Bourne.
- Next generation phenotyping for diagnosis and phenotype-genotype correlations in Kabuki syndrome**, *Nature Scientific Reports*, Quentin Hennocq, Marjolaine Willems, Jeanne Amiel, Stéphanie Arpin, Tania Attie-Bitach, Thomas Bongibault, Thomas Bouygues, Valérie Cormier-Daire, Pierre Corre, Klaus Dieterich, Maxime Douillet, Jean Feydy, Eva Galliani, Fabienne Giuliano, Stanislas Lyonnet, Arnaud Picard, Thantrira Porntaveetus, Marlène Rio, Flavien Rouxel, Vorasuk Shotelersuk, Annick Toutain, Kevin Yauy, David Geneviève, Roman H. Khonsari and Nicolas Garcelon.
- 2023 **DiffMaSIF: Surface-based Protein-Protein Docking with Diffusion Models**, MLSB 2023 (NeurIPS workshop), Freyr Sverrisson, Mehmet Akdel, Dylan Abramson, Jean Feydy, Alexander Goncearenco, Yusuf Adeshina, Daniel Kovtun, Céline Marquet, Xuejin Zhang, David Baugher, Zachary Wayne Carpenter, Luca Naef, Michael Bronstein, Bruno Correia.
- Artificial intelligence in diagnostic and interventional radiology: Where are we now?**, *Diagnostic and Interventional Imaging*, Tom Boeken, Jean Feydy, Augustin Lecler, Philippe Soyer, Antoine Feydy, Maxime Barat, Loïc Duron.
- Artificial intelligence in musculoskeletal oncology imaging: A critical review of current applications**, *Diagnostic and Interventional Imaging*, Maxime Lacroix, Theodore Aouad, Jean Feydy, David Biau, Frédérique Larousserie, Laure Fournier, Antoine Feydy.
- Accelerating high-dimensional temporal modelling using Graphics Processing Units for pharmacovigilance signal detection on real-life data**, *Challenges of Trustable AI and Added-Value on Health*, Pierre Sabatier, Jean Feydy, Anne-Sophie Jannot.
- 2022 **Collective proposal distributions for nonlinear MCMC samplers: mean-field theory and fast implementation**, *Electronic Journal of Statistics*, Grégoire Clarté, Antoine Diez, Jean Feydy.

Physics-informed deep neural network for rigid-body protein docking, *MLDD workshop (spotlight presentation) at ICLR 2022*, Freyr Sverrisson, Jean Feydy, Joshua Southern, Michael Bronstein, Bruno Correia.

- 2021 **Accurate point cloud registration with robust optimal transport**, *NeurIPS 2021*, Zhengyang Shen*, Jean Feydy*, Peirong Liu, Ariel Hernán Curiale, Ruben San José Estépar, Raúl San José Estépar, Marc Niethammer.
Fast end-to-end learning on protein surfaces, *CVPR 2021*, Freyr Sverrisson*, Jean Feydy*, Bruno Correia, Michael Bronstein.
Kernel operations on the GPU, with autodiff, without memory overflows, *Journal of Machine Learning Research*, Benjamin Charlier*, Jean Feydy*, Joan Glaunès*, François-David Collin, Ghislain Durif.
- 2020 **Fast geometric learning with symbolic matrices**, *NeurIPS 2020 (spotlight presentation)*, Jean Feydy*, Joan Glaunès*, Benjamin Charlier*, Michael Bronstein.
Geometric data analysis, beyond convolutions, *PhD thesis in applied mathematics*, defended on July 2, 2020.
- 2019 **Fast and Scalable Optimal Transport for Brain Tractograms**, *MICCAI 2019*, Jean Feydy*, Pierre Roussillon*, Alain Trouvé, Pietro Gori.
Interpolating between Optimal Transport and MMD using Sinkhorn divergences, *AiStats 2019*, Jean Feydy, Thibault Séjourné, François-Xavier Vialard, Shun-ichi Amari, Alain Trouvé, Gabriel Peyré.
- 2018 **Global divergences between measures: from Hausdorff distance to Optimal Transport**, *ShapeMI workshop (oral presentation) at MICCAI 2018*, Jean Feydy, Alain Trouvé.
- 2017 **Optimal Transport for Diffeomorphic Registration**, *MICCAI 2017 (oral presentation)*, Jean Feydy, Benjamin Charlier, F.-X. Vialard, Gabriel Peyré.
Distortion minimizing geodesic subspaces in shape spaces and computational anatomy, *VipImage 2017*, Benjamin Charlier, Jean Feydy, David W. Jacobs and Alain Trouvé.

Teaching

- since 2023 **Linear models**, 2nd year of medical school, “médecine-sciences” track, Université Paris-Cité.
- since 2022 **Geometric data analysis**, Master 2 “Mathématiques, Vision, Apprentissage”, ENS Paris-Saclay et chaire IA de l’Université Paris-Cité.
- since 2022 **GPU computing**, Master 2 “Données massives en santé”, Université Paris-Cité.
- since 2020 **AI session**, DIU brain aging in neuroradiology for French radiologists.
- 2022–2024 **Advanced AI**, Healthcare major (M2 level) at the EPITA school of software engineering.
- 2019–2022 **Workshop session on image processing and computational anatomy**, AI-Radiology Masterclass for radiology interns of the Paris region.
- 2018 **Workshop session on computational anatomy**, GeomData summer school, Fréjus.

- 2016–2019 **Tutor and teaching assistant (“Caïman”), École Normale Supérieure (Paris).**
- Introduction to Riemannian geometry through the study of shapes spaces – lectures and monitoring of a reading group.
 - Mathematical Foundations of Data Sciences (wavelets, sparsity, CNNs and optimal transport) – workshop sessions, with lectures by Gabriel Peyré.
 - Mathematical Culture: a journey from highschool to research, with applications – lectures targeted at computer scientists, physicists, philosophers, etc. from the ENS.
- Redaction of three ~150 pages long manuals – one for each class.
- 2012–2016 **Teaching assistant (mathematics) in preparatory classes, MPSI and MP*, Lycée Marcelin Berthelot, Saint-Maur-des-Fossés and Lycée Louis-le-Grand, Paris.**

Doctoral supervision

- 2024–2027 **Guillaume Houry**, *Optimal transport for robust medical image registration*, École Doctorale MSTIC (ED532), co-supervised with François-Xavier Vialard.
- 2023–2026 **Eya Abid**, *Analysis of Cryo-EM data with geometric deep learning to reconstruct the conformational manifold of biomolecules*, École Doctorale EDITE (ED130), co-supervised with Slavica Jonic.
- 2023–2026 **Hadrien Bigo–Balland**, *Measurement of anatomical data from 3D scans of body parts acquired by a smartphone*, École Doctorale de Sciences Mathématiques de Paris Centre (ED386), CIFRE PhD with MyFit Solutions, co-supervised with Stéphanie Allassonnière.
- 2022–2025 **Guillaume Sérieys**, *Optimal transport and metamorphoses for multimodal brain tumor image registration*, École Doctorale de Sciences Mathématiques de Paris Centre (ED386), co-supervised with Joan Glaunès and Pietro Gori.