

Design of machine learning and statistical models to discover brain predictive signatures of psychiatric disorders
As a leader of the team “Signatures of brain disorders” at NeuroSpin, CEA, Paris-Saclay University, France, I supervise the design of machine learning and statistical models to uncover neural signatures predictive of clinical trajectories in psychiatric disorders. To unlock the access to data required by learning algorithms, I oversee the data management, calculation, and regulation (GDPR) of large-scale national and European initiatives.

Keywords: Machine/Deep Learning – AI – Statistics – Neuroimaging – Scientific computing – Data management

Positions

- 2021–now **Research Director**, NeuroSpin, CEA, Paris-Saclay University, France, ML & Neuroimaging
- 2008–2021 **Research Scientist**, NeuroSpin, CEA, Paris-Saclay University, France, ML & Neuroimaging
- 2005–2008 **R&D Engineer**, INSERM Unit “Neuroimaging and Psychiatry”, Orsay, France, ML & Neuroimaging
- 2003–2004 **Postdoc**, CEA, Orsay, France, ML & Neuroimaging
- 2002 **Software Engineer**, MBD.A (Matra BAe Dynamics) Velizy, France, Object-oriented prog., C++
- 2001–2002 **Teaching and Research Assistant**, Rennes 1 University, France, Signal & Image processing, Object-oriented programming, Java

Education

- 2020 **Habilitation (for full professorship)**, Paris-Saclay University, France, ML & Neuroimaging
- 1999–2001 **Ph.D.**, LTSI (lab. of signal and image processing). Rennes 1 University, France, AI in medical imaging
- 1997–1998 **Master’s degree**, Rennes 1 University, France, Signal & Image Processing
- 1994–1997 **Master’s degree**, EPITA, France, Software Engineering

Projects

- 2024–2029 **Work Package (WP) leader of data analysis, computing and data management**, IHU ICE: Institut Hospitalo-Universitaire-Institut du Cerveau de l’Enfant Robert , Leaders: R Delorme, G Dehaene, T Bourgeron, Team budget: 2M€
- 2023–2028 **WP leader of data analysis, large-scale computing and datamanagement**, PEPR Santé Mentale PROPSY: PROgram-project in Precision pSYchiatry, Leader: M Leboyer, Team budget: 4.6M€
- 2022–2026 **WP leader of data analysis**, RHU FAME: Improving FAMily members’ Experience in the ICU, Leader: E Azoulay, Team budget: 547k€
- 2020–2024 **Leader of Artificial Intelligence (AI) Chair**, ANR Big2Small, Transfer Learning from Big Data to Small Data: Leveraging Psychiatric Neuroimaging Biomarkers Discovery, Budget: 543k€
- 2019–2026 **WP leader of data analysis**, RHU PsyCARE. Preventing psychosis through personalized care, Leader: MO Krebs, Team budget: 715k€
- 2018–2023 **WP leader of data analysis, computing and management**, Horizon Europe R-LiNK. Optimizing response to Li treatment through personalized evaluation of individuals with bipolar I disorder, Leader: F Bellivier, Team budget: 800k€
- 2014–2018 ANR BIP-Li7 (ANR-14-CE15-0003) Therapeutic Lithium response in Bipolar Disorders and brain Lithium-7 NMR Spectroscopy Imaging at 7 Tesla, Leader: F Bellivier, WP leader: F Boumezbeur, Team budget: 280k€
- 2011–2015 **WP leader of data analysis**, EU FP6-ERA-NET-NEURON MESCOG: Mechanisms of Small Vessel-Related Brain Damage and Cognitive Impairment: Integrating Imaging Findings from Genetic and Sporadic Disease, Leader: M Dichgans, Team budget: 195k€
- 2012–2016 **WP leader of image analysis**, BRAINOMICS (ANR-10-BINF-04) Methodological and software solutions for the integration of neuroimaging and genomic data, Leader: V Frouin, 800k€
- 2010–2013 **Leader (with A Roche)**, ANR Karamétrie (ANR-09-BLAN-0332): A unified framework for feature-based morphometry of the brain, Team budget: 200k€
- 2007–2010 **WP Leader of data analysis**, ANR AGIR (ANR-07-NEUR-0001): Autism: Genetic and Imaging Research, Leader: M. Zilbovicius, Team budget: 150k€

2007–now Contribution to the CATI platform, *a national platform created by the French Alzheimer plan in 2011 to support multicenter neuroimaging studies* (9M€ grant), sLeader: JF Mangin

Teaching

I wrote a course on Statistics and Machine Learning in Python, github: Jupyter notebooks and python sources and . I deliver lectures on machine learning/statistics in:

- 2019–now *Introduction to AI: main algorithms of machine learning* in **Master 2** radiophysique médicale Paris-Saclay University
- 2015–now Machine learning in **Master 2** Innovation, marché et science des données IMSD, Paris-Saclay University, head: Ekaterina Kalugina
- 2018–now: Machine learning in **Master 2** Modelisations Statistiques Economique & Financières MoSeF, Panthéon Sorbonne Paris 1 University, head: Rania Hentati Kaffel
- 2017–2020 Biostatistics **3rd year of CentralSupélec**, Paris-Saclay University, head: Arthur Tenenhaus
- 2019–2020 Machine learning in **2nd & 3rd years of EPITA**, Kremlin-Bicêtre, Image processing option, head: Elodie Puybureau and Guillaume Tochon
- 2016–2017 Data analysis in **Master 1** Mathématiques et applications, option “Ingénierie mathématique pour les sciences du vivant”, Paris Descartes University, head: Etienne Birmele

Supervision experience

Ph.D.s

- 2022–now Thibault Dupont together with Elie Azoulay
- 2022–now Sara Petiton together with Antoine Grigis
- 2022–now Pierre Auriau together with Pietro Gori, Antoine Grigis, and Jean-François Mangin
- 2020–now Robin Louiset together with Pietro Gori and Antoine Grigis
- 2019–2022 Benoit Dufumier, together with Arthur Tenenhaus, Pietro Gori and Antoine Grigis
- 2019–2021 Anton Iftimovici, together with Marie-Odile Krebs
- 2016–2019 Amicie de Pierrefeu, together with Philippe Ciuciu
- 2008–2012 Edith Lefloch together with V Frouin
- 2009–2011 Cecilia Damon together with JB Poline

Post-docs

- 2017–2019 Pauline Favre, Post-doc, together with JF Mangin and J. Houenou
- 2016 Pietro Gori, Post-doc together with JF Mangin and J. Houenou
- 2013–2015 Fouad Hadj Seleem
- 2013–2015 Tommy Lofstedt

Engineers

- 2023–now Raphael Vock together with Antoine Grigis
- 2022–now Bérangère Dollé together with Antoine Grigis
- 2021–now Loic Dorval together with Antoine Grigis
- 2019–2022 Julie Victor together with Antoine Grigis
- 2013–2014 Mathieu Dubois
- 2014 Clémence Pinaud
- 2013–2014 Jinpeng Li

Bibliometry

Publications 94(a), 131(b). (a) Web of Science, (b) Google scholar
Citations 38,291(a), 86,070(b)
H-Index 26(a), 34(b)

- [Dup+24] T. Dupont, N. Kentish-Barnes, F. Pochard, E. Duchesnay, and E. Azoulay. "Prediction of post-traumatic stress disorder in family members of ICU patients: a machine learning approach". In: *Intensive Care Medicine* 50.1 (Jan. 1, 2024), pp. 114–124.
- [Poi+24] C. Poiret, A. Bouyeure, S. Patil, C. Boniteau, E. Duchesnay, A. Grigis, F. Lemaitre, and M. Noulhiane. "Attention-gated 3D CapsNet for robust hippocampal segmentation". In: *Journal of Medical Imaging (Bellingham, Wash.)* 11.1 (Jan. 2024), p. 014003.
- [Ela+23] Y. Elandaloussi, D. L. Floris, P. Coupé, E. Duchesnay, A. Mihailov, A. Grigis, I. Bègue, J. Victor, V. Frouin, M. Leboyer, J. Houenou, and C. Laidi. "Understanding the relationship between cerebellar structure and social abilities". In: *Molecular Autism* 14.1 (May 15, 2023), p. 18.
- [Fra+23] J. Fraize, C. Fischer, M. Elmaleh-Bergès, E. Kerdreux, A. Beggiato, A. Ntorkou, E. Duchesnay, D. Bekha, O. Boespflug-Tanguy, R. Delorme, L. Hertz-Pannier, and D. Germanaud. "Enhancing fetal alcohol spectrum disorders diagnosis with a classifier based on the intracerebellar gradient of volumetric undersizing". In: *Human Brain Mapping* 44.11 (2023). _eprint: <https://onlinelibrary.wiley.com/doi/pdf/10.1002/hbm.26348>, pp. 4321–4336.
- [Ift+23a] A. Iftimovici, J. Bourgin, J. Houenou, O. Gay, A. Grigis, J. Victor, B. Chaumette, M.-O. Krebs, E. Duchesnay, and ICAAR-plus Study Group. "Asynchronous neural maturation predicts transition to psychosis". In: *Psychiatry and Clinical Neurosciences* (Oct. 30, 2023).
- [Ift+23b] A. Iftimovici, Q. He, C. Jiao, E. Duchesnay, M.-O. Krebs, O. Kebir, and B. Chaumette. "Longitudinal MicroRNA Signature of Conversion to Psychosis". In: *Schizophrenia Bulletin* (Aug. 22, 2023), sbad080.
- [Poi+23] C. Poiret, A. Bouyeure, S. Patil, A. Grigis, E. Duchesnay, M. Faillot, M. Bottlaender, F. Lemaitre, and M. Noulhiane. "A fast and robust hippocampal subfields segmentation: HSF revealing lifespan volumetric dynamics". In: *Frontiers in Neuroinformatics* 17 (2023).
- [Duf+22] B. Dufumier, A. Grigis, J. Victor, C. Ambroise, V. Frouin, and E. Duchesnay. "OpenBHB: a Large-Scale Multi-Site Brain MRI Data-set for Age Prediction and Debiasing". In: *NeuroImage* (Sept. 17, 2022), p. 119637.
- [Fov+22] T. Fovet, P. Yger, R. Lopes, A. de Pierrefeu, E. Duchesnay, J. Houenou, P. Thomas, S. Szaffarczyk, P. Domenech, and R. Jardri. "Decoding Activity in Broca's Area Predicts the Occurrence of Auditory Hallucinations Across Subjects". In: *Biological Psychiatry. Biomarkers of Psychosis* 91.2 (Jan. 15, 2022), pp. 194–201.
- [Ift+22] A. Iftimovici, B. Chaumette, E. Duchesnay, and M.-O. Krebs. "Brain anomalies in early psychosis: From secondary to primary psychosis". In: *Neuroscience & Biobehavioral Reviews* (June 1, 2022), p. 104716.
- [Lai+22] C. Laidi, D. L. Floris, J. Tillmann, Y. Elandaloussi, M. Zabihi, T. Charman, T. Wolfers, S. Durston, C. Moessnang, F. Dell'Acqua, C. Ecker, E. Loth, D. Murphy, S. Baron-Cohen, J. K. Buitelaar, A. F. Marquand, C. F. Beckmann, V. Frouin, M. Leboyer, E. Duchesnay, P. Coupé, and J. Houenou. "Cerebellar atypicalities in autism?" In: *Biological Psychiatry* (May 22, 2022).
- [Fov+21] T. Fovet, P. Yger, R. Lopes, A. de Pierrefeu, E. Duchesnay, J. Houenou, P. Thomas, S. Szaffarczyk, P. Domenech, and R. Jardri. "Decoding Activity in Broca's Area Predicts the Occurrence of Auditory Hallucinations Across Subjects". In: *Biological Psychiatry* (Sept. 8, 2021), S0006–3223(21)01569–9.
- [Pig+21] C. Piguet, A. Mihailov, A. Grigis, C. Laidi, E. Duchesnay, and J. Houenou. "Irritability Is Associated With Decreased Cortical Surface Area and Anxiety With Decreased Gyrfication During Brain Development". In: *Frontiers in Psychiatry* 12 (2021), p. 744419.
- [Chi+20] C. R. K. Ching et al. "What we learn about bipolar disorder from large-scale neuroimaging: Findings and future directions from the ENIGMA Bipolar Disorder Working Group". In: *Human Brain Mapping* (July 29, 2020).
- [Cla+20] L.-A. Claude, J. Houenou, E. Duchesnay, and P. Favre. "Will machine learning applied to neuroimaging in bipolar disorder help the clinician? A critical review and methodological suggestions". In: *Bipolar Disorders* (Feb. 28, 2020).
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- [Man+20] J.-F. Mangin, D. Rivière, E. Duchesnay, Y. Cointepas, V. Gaura, C. Verny, P. Damier, P. Krystkowiak, A.-C. Bachoud-Lévi, P. Hantraye, P. Remy, and G. Douaud. "Neocortical morphometry in Huntington's disease: Indication of the coexistence of abnormal neurodevelopmental and neurodegenerative processes". In: *NeuroImage. Clinical* 26 (Feb. 13, 2020), p. 102211.

- [Sto+20] J. Stout, F. Hozer, A. Coste, F. Mauconduit, N. Djebrani-Oussedik, S. Sarrazin, J. Poupon, M. Meyrel, S. Romanzetti, B. Etain, C. Rabrait-Lerman, J. Houenou, F. Bellivier, E. Duchesnay, and F. Boumezbaur. "Accumulation of Lithium in the Hippocampus of Patients With Bipolar Disorder: A Lithium-7 Magnetic Resonance Imaging Study at 7 Tesla". In: *Biological Psychiatry* 88.5 (Sept. 1, 2020), pp. 426–433.
- [Bou+19] J. Bourgin, E. Duchesnay, E. Magaud, R. Gaillard, M. Kazes, and M.-O. Krebs. "Predicting the individual risk of psychosis conversion in at-risk mental state (ARMS): a multivariate model reveals the influence of nonpsychotic prodromal symptoms". In: *European Child & Adolescent Psychiatry* (Dec. 23, 2019).
- [Fav+19] P. Favre, M. Pauling, J. Stout, F. Hozer, S. Sarrazin, C. Abé, M. Alda, C. Alloza, S. Alonso-Lana, O. A. Andreassen, B. T. Baune, F. Benedetti, G. F. Busatto, E. J. Canales-Rodríguez, X. Caseras, T. M. Chaim-Avancini, C. R. K. Ching, U. Dannlowski, M. Deppe, L. T. Eyler, M. Fatjo-Vilas, S. F. Foley, D. Grotegerd, T. Hajek, U. K. Haukvik, F. M. Howells, N. Jahanshad, H. Kugel, T. V. Lagerberg, S. M. Lawrie, J. O. Linke, A. McIntosh, E. M. T. Melloni, P. B. Mitchell, M. Polosan, E. Pomarol-Clotet, J. Reppe, G. Roberts, A. Roos, P. G. P. Rosa, R. Salvador, S. Sarró, P. R. Schofield, M. H. Serpa, K. Sim, D. J. Stein, J. E. Sussmann, H. S. Temmingh, P. M. Thompson, N. Verdolini, E. Vieta, M. Wessa, H. C. Whalley, M. V. Zanetti, M. Leboyer, J.-F. Mangin, C. Henry, E. Duchesnay, and J. Houenou. "Widespread white matter microstructural abnormalities in bipolar disorder: evidence from mega- and meta-analyses across 3033 individuals". In: *Neuropsychopharmacology* (Aug. 21, 2019). tex.ids: favre_correction_2019, pp. 1–11.
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- [Lai+19b] C. Laidi, J. Boisgontier, A. de Pierrefeu, E. Duchesnay, S. Hotier, M.-A. d'Albis, R. Delorme, F. Bolognani, C. Czech, C. Bouquet, A. Amestoy, J. Petit, Š. Holiga, J. Dukart, A. Gaman, E. Toledano, M. Ly-Le Moal, I. Scheid, M. Leboyer, and J. Houenou. "Decreased Cortical Thickness in the Anterior Cingulate Cortex in Adults with Autism". In: *Journal of Autism and Developmental Disorders* 49.4 (Apr. 2019), pp. 1402–1409.
- [Sco+19] J. Scott, D. Hidalgo-Mazzei, R. Strawbridge, A. Young, M. Resche-Rigon, B. Etain, O. A. Andreassen, M. Bauer, D. Bennabi, A. M. Blamire, F. Boumezbaur, P. Brambilla, N. Cattane, A. Cattaneo, M. Chupin, K. Coello, Y. Cointepas, F. Colom, D. A. Cousins, C. Dubertret, E. Duchesnay, A. Ferro, A. Garcia-Estela, J. Goikolea, A. Grigis, E. Haffen, M. C. Høegh, P. Jakobsen, J. L. Kalman, L. V. Kessing, F. Klohn-Saghatolislam, T. V. Lagerberg, M. Landén, U. Lewitzka, A. Lutticke, N. Mazer, M. Mazzelli, C. Mora, T. Muller, E. Mur-Mila, K. J. Oedegaard, L. Oltegal, E. Pålsson, D. Papadopoulos Orfanos, S. Papiol, V. Perez-Sola, A. Reif, P. Ritter, R. Rossi, T. Schulze, F. Senner, F. E. Smith, L. Squarcina, N. E. Steen, P. E. Thelwall, C. Varo, E. Vieta, M. Vinberg, M. Wessa, L. T. Westlye, and F. Bellivier. "Prospective cohort study of early biosignatures of response to lithium in bipolar-I-disorders: overview of the H2020-funded R-LiNK initiative". In: *International Journal of Bipolar Disorders* 7.1 (Sept. 25, 2019), p. 20.
- [Duc+18] E. Duchesnay, F. Hadj Seleem, F. De Guio, M. Dubois, J.-F. Mangin, M. Duering, S. Ropele, R. Schmidt, M. Dichgans, H. Chabriat, and E. Jouvent. "Different Types of White Matter Hyperintensities in CADASIL". In: *Frontiers in Neurology* 9 (2018).
- [Had+18a] F. Hadj-Seleem, T. Löfstedt, E. Dohmatob, V. Frouin, M. Dubois, V. Guillemot, and E. Duchesnay. "Continuation of Nesterov's Smoothing for Regression With Structured Sparsity in High-Dimensional Neuroimaging". In: *IEEE Transactions on Medical Imaging* 37.11 (Nov. 2018). tex.ids: hadj-selem_continuation_2016 Conference Name: IEEE Transactions on Medical Imaging, pp. 2403–2413.
- [Leb+18] J. Lebenberg, M. Labit, G. Auzias, H. Mohlberg, C. Fischer, D. Rivière, E. Duchesnay, C. Kabdebon, F. Leroy, N. Labra, F. Poupon, T. Dickscheid, L. Hertz-Pannier, C. Poupon, G. Dehaene-Lambertz, P. Hüppi, K. Amunts, J. Dubois, and J.-F. Mangin. "A framework based on sulcal constraints to align preterm, infant and adult human brain images acquired in vivo and post mortem". In: *Brain Structure & Function* 223.9 (Dec. 2018), pp. 4153–4168.
- [Löf+18] T. Löfstedt, V. Guillemot, V. Frouin, E. Duchesnay, and Hadj-Seleem. "Simulated Data for Linear Regression with Structured and Sparse Penalties: Introducing pylearn-simulate | Löfstedt | Journal of Statistical Software". In: *Journal of Statistical Software* 87.3 (2018).
- [Nun+18] A. Nunes, H. G. Schnack, C. R. K. Ching, I. Agartz, T. N. Akudjedu, M. Alda, D. Alnæs, S. Alonso-Lana, J. Bauer, B. T. Baune, E. Bøen, C. D. M. Bonnin, G. F. Busatto, E. J. Canales-Rodríguez, D. M. Cannon, X. Caseras, T. M. Chaim-Avancini, U. Dannlowski, A. M. Díaz-Zuluaga, B. Dietsche, N. T. Doan, E. Duchesnay, T. Elvsåshagen, D. Emden, L. T. Eyler, M. Fatjó-Vilas, P. Favre, S. F. Foley, J. M. Fullerton, D. C. Glahn, J. M. Goikolea, D. Grotegerd, T. Hahn, C. Henry, D. P. Hibar, J. Houenou, F. M. Howells, N. Jahanshad, T. Kaufmann, J. Kenney, T. T. J. Kircher, A. Krug, T. V. Lagerberg, R. K. Lenroot, C. López-Jaramillo, R. Machado-Vieira, U. F. Malt, C. McDonald, P. B. Mitchell, B. Mwangi, L. Nabulsi, N. Opel, B. J. Overs, J. A. Pineda-Zapata,

E. Pomarol-Clotet, R. Redlich, G. Roberts, P. G. Rosa, R. Salvador, T. D. Satterthwaite, J. C. Soares, D. J. Stein, H. S. Temmingh, T. Trappenberg, A. Uhlmann, N. E. M. van Haren, E. Vieta, L. T. Westlye, D. H. Wolf, D. Yüksel, M. V. Zanetti, O. A. Andreassen, P. M. Thompson, T. Hajek, and ENIGMA Bipolar Disorders Working Group. "Using structural MRI to identify bipolar disorders - 13 site machine learning study in 3020 individuals from the ENIGMA Bipolar Disorders Working Group". In: *Molecular Psychiatry* (Aug. 31, 2018).

- [Pie+18a] A. de Pierrefeu, T. Löfstedt, C. Laidi, F. Hadj-Selem, J. Bourgin, T. Hajek, F. Spaniel, M. Kolenic, P. Ciuciu, N. Hamdani, M. Leboyer, T. Fovet, R. Jardri, J. Houenou, and E. Duchesnay. "Identifying a neuroanatomical signature of schizophrenia, reproducible across sites and stages, using machine learning with structured sparsity". In: *Acta Psychiatrica Scandinavica* 0.0 (2018).
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- [Pie+18c] A. de Pierrefeu, T. Lofstedt, F. Hadj-Selem, M. Dubois, R. Jardri, T. Fovet, P. Ciuciu, V. Frouin, and E. Duchesnay. "Structured Sparse Principal Components Analysis With the TV-Elastic Net Penalty". In: *IEEE Transactions on Medical Imaging* 37.2 (Feb. 2018). tex.ids: de2018structured, de_pierrefeu_structured_2017 tex.publisher: IEEE, pp. 396–407.
- [Le +17] Y. Le Guen, G. Auzias, F. Leroy, M. Noulhiane, G. Dehaene-Lambertz, E. Duchesnay, J.-F. Mangin, O. Coulon, and V. Frouin. "Genetic Influence on the Sulcal Pits: On the Origin of the First Cortical Folds". In: *Cerebral Cortex* (2017). tex.ids: le_guen_genetic_2018, pp. 1–12.
- [Mag+17] R. Magalhães, J. Bourgin, F. Boumezeur, P. Marques, M. Bottlaender, C. Poupon, B. Djemaï, E. Duchesnay, S. Mériaux, N. Sousa, T. M. Jay, and A. Cachia. "White matter changes in microstructure associated with a maladaptive response to stress in rats". In: *Translational Psychiatry* 7.1 (Jan. 24, 2017), e1009.
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- [Pir+16] L. Pirpamer, E. Hofer, B. Gesierich, F. De Guio, P. Freudenberger, S. Seiler, M. Duering, E. Jouvent, E. Duchesnay, M. Dichgans, et al. "Determinants of iron accumulation in the normal aging brain". In: *Neurobiology of aging* 43 (2016), pp. 149–155.
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