

# Pedro L. C. Rodrigues

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## Research experience

**Post-doctoral researcher**, Parietal team, Inria-Saclay, Palaiseau, France. Working on the group of Dr. Alexandre Gramfort since 01/Mar/2020.

- **Project:** Algorithms for simulation-based inference with applications to computational neuroscience. Main publication: [\( \$\alpha\$ \)](#)

**Doctoral researcher**, VIBS Team, GIPSA-lab, Grenoble, France. Worked under the supervision of Dr. Marco Congedo and Prof. Christian Jutten from 01/Oct/2016 until 31/Dec/2019.

- **Project:** Methods for analysis and classification of multivariate time series. Applications mainly to neural signals. Main publications: [\( \$\beta\$ \)](#) and [\( \$\gamma\$ \)](#)

**Graduate researcher**, Escola Politécnica da USP, São Paulo, Brazil. Worked under the supervision of Prof. Luiz A. Baccalá from 01/Jan/2014 until 30/Sep/2016.

- **Project:** Methods for detecting and characterizing neural connectivity in event-related potentials. Main publications: [\( \$\delta\$ \)](#)

## Education

**Ph.D. in “Signal, Image, Parole, and Télécoms”**, Université Grenoble Alpes, Grenoble, France, from 01/Oct/2016 until 30/Sep/2019. Ph.D. defense: 16/Oct/2019. Jury presided by Patrick Flandrin and composed by Alexandre Gramfort (reader), Yannick Berthoumieu (reader), Fabien Lotte, and Stéphane Canu. Supervision of Dr. Marco Congedo and Prof. Christian Jutten.

- Title of the thesis: “*Exploring invariances of multivariate time series via Riemannian geometry: validation on EEG data*”. Available at [tel-02345388](#)

**Master of science**, Universidade de São Paulo, São Paulo, Brazil, from 01/Jan/2014 until 31/Jul/2016. Supervision of Prof. Luiz A. Baccalá.



- Title of the dissertation: “*Algorithms for inference of neural connectivity in event-related potentials*”. DOI: [10.11606/D.3.2017.tde-17032017-094453](#)

**Diplôme de l'Ecole Polytechnique**, Ecole Polytechnique, Palaiseau, France, from 01/Apr/2011 until 31/Jul/2015. Double degree program with the Escola Politécnica da Universidade de São Paulo, Brazil.

**Engineering degree in Telecommunications**, Escola politécnica da Universidade de São Paulo, São Paulo, Brazil, from 01/Jan/2008 until 31/Dec/2013. Double degree program with the Ecole Polytechnique, France.

## Main publications

- ( $\alpha$ ) **PLC Rodrigues**, T Moreau, G Louppe, A Gramfort, “Leveraging Global Parameters for Flow-based Neural Posterior Estimation”. Preliminary work under review. Available at [arXiv:2102.06477](#) [↗](#)
- ( $\beta$ ) **PLC Rodrigues**, M Congedo, C Jutten, “Dimensionality transcending: a method for merging BCI datasets with different dimensionalities,” IEEE Transactions on Biomedical Engineering, July, 2020, in press. Available at [hal-02905045](#) [↗](#) .

- ( $\gamma$ ) **PLC Rodrigues**, C Jutten, M Congedo, "Riemannian Procrustes analysis: transfer learning for brain-computer interfaces," IEEE Transactions on Biomedical Engineering, vol. 66, no. 8, pp. 2390-2401, December, 2018. Available at [hal-01971856](#) .
- ( $\delta$ ) **PLC Rodrigues** and LA Baccalá, "A new algorithm for neural connectivity estimation of EEG event related potentials," 2015 37th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC), Milan, 2015, pp. 3787-3790. DOI: [10.1109/EMBC.2015.7319218](#) .

## Teaching experience

**Teaching assistant**, *ENSE3 (Grenoble INP)*, Course on "Signal processing" (TP, BE, and TD) to students of the 2nd year of the engineering program, 56 hours in total between 2017 and 2019. Professor responsible for the course: Pierre Granjon (GIPSA-lab).

**Teaching assistant**, *PHELMA (Grenoble INP)*, Course on "Numerical optimization" (TP and BE) to students of the 2nd year of the engineering program, 20 hours in total from 2017 until 2019. Professor responsible for the course: Bertrand Rivet (GIPSA-lab).

**Teaching assistant**, *ENSIMAG (Grenoble INP)*, Course on "Data mining and statistical data analysis" (TP and TD) to students of the 2nd year of the engineering program, 32 hours in total from 2017 until 2019. Professor responsible for the course: Jean-Baptiste Durand (Laboratoire Jean Kuntzmann).

**Teaching assistant**, *Escola Politécnica da Universidade de São Paulo*, Course on "Stochastic processes" to students of the 3rd year of the engineering program, 40 hours in 2013. Professor responsible for the course: Luiz A Baccalá (Universidade de São Paulo).

## Other scientific activities

**Reviewer** for NeuroImage (impact factor: 5.90), IEEE Transactions on Biomedical Engineering (impact factor: 4.42), and IEEE Transactions on Neural Systems and Rehabilitation Engineering (impact factor: 3.34).

**Regular contributions** to several open-source packages:

- `pyriemann`, a Python package for manipulating covariance matrices respecting the intrinsic geometry of the manifold that they define.
- `MOABB`, a comprehensive benchmark of popular classification methods for brain-computer interface applied on an extensive list of freely available EEG datasets.
- `sbi`, a PyTorch package for simulation-based inference.

**Invited talk** at the "Covariance matrix advances for machine learning" day for the GdR-ISIS group from the CNRS. Online presentation in Dec/2020.

**Co-creator and maintainer** of 7 publicly available datasets containing experimental recordings carried out at the GIPSA-lab in Grenoble, France. Each dataset contains a link for download, a detailed documentation, and a repository with minimal working code. See [plcrodrigues.github.io/code](#) for details.

**Organization of a one-day workshop** on "Benchmarking BCI classification methods" with Prof. Sylvain Chevallier (Université Paris-Saclay) during the Graz BCI Conference 2019 in Austria, 20 attendees.

**Presentation at the Pint of Science festival** sharing to a wide audience the latest research developments on brain-computer interfaces. Grenoble, May/2017.

## Full list of publications

The following list is first divided into research topics and then organized in chronological order.

Legend : ■ journal papers ■ conference papers ■ technical reports

Works on **simulation-based inference**. These publications are related to the research topic that I've been developing during my post-doc. Several collaborations are currently under progress with researchers from the University of Liège, Brown University and the ICTP in Italy.

- 1** ■ **PLC Rodrigues**, T Moreau, G Louppe, A Gramfort, "Leveraging Global Parameters for Flow-based Neural Posterior Estimation". Preliminary work under review. Available at [arXiv:2102.06477](https://arxiv.org/abs/2102.06477) ↗
- 2** ■ **PLC Rodrigues** and A Gramfort. "Learning summary features of time series for likelihood free inference". Workshop on Machine Learning and the Physical Sciences at the 34th Conference on Neural Information Processing Systems (NeurIPS). Online conference. December, 2020,. Available at [arXiv:2012.02807](https://arxiv.org/abs/2012.02807) ↗ .
- 3** ■ M Jallais, **PLC Rodrigues**, A Gramfort, D Wassermann. "Cytoarchitecture measurements in brain gray matter using likelihood-free Inference". Accepted for the IPMI 2021 conference. December, 2020. Available at [hal-03090959](https://hal.archives-ouvertes.fr/hal-03090959) ↗ .

Works on **transfer learning**. References [5] and [8] lay the mathematical foundations of my contributions in transfer learning for data defined in a SPD manifold. The other conference papers were all oral presentations, showing the growing interest of the research community in these methods. These works have been cited 34 times (January 2021) and have served as topic of research for a M2 internship in Inria-Nancy directed by Laurent Bougrain and Fabien Lotte and a base framework for a Ph.D. thesis at the GIPSA-lab directed by Marco Congedo and Jérémie Mattout.

- 4** ■ L Bougrain, S Rimbert, **PLC Rodrigues**, G Canron, F Lotte. "Guidelines to use transfer learning for motor imagery detection: an experimental study". Accepted for the IEEE NER2021 conference. December, 2020.
- 5** ■ **PLC Rodrigues**, M Congedo, C Jutten, "Dimensionality transcending: a method for merging BCI datasets with different dimensionalities," IEEE Transactions on Biomedical Engineering, July, 2020, in press. Available at [hal-02905045](https://hal.archives-ouvertes.fr/hal-02905045) ↗ .
- 6** ■ **PLC Rodrigues**, M Congedo, C Jutten. "'When does it work?': An exploratory analysis of transfer learning for BCI". 8th Graz Brain-Computer Interface Conference 2019, September, 2019, Graz, Austria. Oral presentation. *Best student paper award*. Available at [hal-02321580](https://hal.archives-ouvertes.fr/hal-02321580) ↗ .
- 7** ■ **PLC Rodrigues**, M Congedo, C Jutten. "A data imputation method for matrices in the symmetric positive definite manifold". XXVIIème colloque GRETSI (GRETSI 2019), August, 2019, Lille, France. Oral presentation. Available at [hal-02321587](https://hal.archives-ouvertes.fr/hal-02321587) ↗ .
- 8** ■ **PLC Rodrigues**, C Jutten, M Congedo, "Riemannian Procrustes analysis: transfer learning for brain-computer interfaces," IEEE Transactions on Biomedical Engineering, vol. 66, no. 8, pp. 2390-2401, December, 2018. Available at [hal-01971856](https://hal.archives-ouvertes.fr/hal-01971856) ↗ .

Works on **dimensionality reduction**. These were the first published works of my Ph.D. thesis. They are based on the widely known mathematical framework of diffusion maps and extend it to the case of data points defined in the symmetric-positive definite manifold. Reference [8] is the first work in the literature, to the best of my knowledge, that applies these concepts to the analysis of multivariate time series.







- 9** **PLC Rodrigues**, M Congedo, C Jutten. "Multivariate time-series analysis via manifold learning". IEEE Statistical Signal Processing Workshop (SSP 2018), June, 2018, Fribourg-en-Brisgau, Germany. Available at [hal-01868167](#) ↗ .
- 10** **PLC Rodrigues**, F Bouchard, M Congedo, C Jutten. "Dimensionality reduction for BCI classification using Riemannian geometry". 7th Graz Brain-Computer Interface Conference, September, 2017, Graz, Austria. Oral presentation. Available at [hal-01591258](#) ↗ .
- 11** F Bouchard, **PLC Rodrigues**, J Malick, M Congedo. "Réduction de dimension pour la séparation aveugle de sources". XXVIème colloque GRETSI (GRETSI 2017), September, 2017, Juan-Les-Pins, France. Available at [hal-01589766](#) ↗ .
- 12** **PLC Rodrigues**, F Bouchard, M Congedo, C Jutten. "Géométrie Riemannienne appliquée à la réduction de la dimension de signaux EEG pour les interfaces cerveau-machine". XXVIème colloque GRETSI (GRETSI 2017), September 2017, Juan-Les-Pins, France. Oral presentation. Available at [hal-01591252](#) ↗ .
- 13** M Congedo, **PLC Rodrigues**, F Bouchard, A Barachant, C Jutten. "A closed-form unsupervised geometry-aware dimensionality reduction method in the Riemannian manifold of SPD matrices". 39th International Conference of the IEEE Engineering in Medicine and Biology Society, Jeju Island (EMBC), IEEE, July, 2017, Jeju Island, South Korea. pp.3198-3201. Available at [hal-01563153](#) ↗ .

Works on **neural connectivity estimation**. These were my first published works containing the results of the research developed during my master of science in Brazil. Both papers were accepted on a prestigious international conference in biomedical engineering.

- 14** **PLC Rodrigues** and LA Baccalá, "Statistically significant time-varying neural connectivity estimation using generalized partial directed coherence," 2016 38th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC), Orlando, Florida, 2016, pp. 5493-5496. *Finalist of the best student paper award*. Oral presentation. DOI: [10.1109/EMBC.2016.7591970](#) ↗ .
- 15** **PLC Rodrigues** and LA Baccalá, "A new algorithm for neural connectivity estimation of EEG event related potentials," 2015 37th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC), Milan, 2015, pp. 3787-3790. Oral presentation. DOI: [10.1109/EMBC.2015.7319218](#) ↗ .

**Technical reports** documenting experimental data collected at the GIPSA-lab during several recording sessions with EEG-based brain-computer interfaces (BCI). Each report is accompanied of a link at zenodo to download the dataset and a github repository with a minimal working example. These datasets are unique in their completeness and have been well accepted by the BCI research community, with a growing number of methodological papers using them as benchmarks.

- 16** L Karczowski, M Cederhout, A Andreev, G Cattan, **PLC Rodrigues**, et al. "Brain invaders cooperative versus competitive: Multi-user P300-based brain-computer interface dataset". Research report. GIPSA-lab. 2019. Report available at [hal-02173913](#) ↗ .
- 17** L Karczowski, E Ostaschenko, A Andreev, G Cattan, **PLC Rodrigues**, et al. "Brain invaders calibration-less P300-based BCI using dry EEG electrodes". Research report. GIPSA-lab. 2019. Report available at [hal-02171575](#) ↗ .
- 18** L Karczowski, M Cederhout, A Andreev, G Cattan, **PLC Rodrigues**, et al. "Brain invaders calibration-less P300-based BCI with modulation of flash duration". Research report. GIPSA-lab. 2019. Report available at [hal-02172347](#) ↗ .

- 19** G van Veen, A Barachant, A Andreev, G Cattan, **PLC Rodrigues**, et al. "Building brain invaders: EEG data of an experimental validation". Research report. GIPSA-lab. 2019. Report available at [hal-02126068](#)  .
- 20** E Vaineau, A Barachant, A Andreev, **PLC Rodrigues**, G Cattan, et al. "Brain invaders adaptive versus non-adaptive P300 brain-computer interface dataset". Research report. GIPSA-lab. 2019. Report available at [hal-02103098](#)  .
- 21** G Cattan, **PLC Rodrigues**, M Congedo. "Passive head-mounted display music-listening EEG dataset". Research report. GIPSA-lab and IHMTEK. 2019. Report available at [hal-02085118](#)  .
- 22** G Cattan, A Andreev, **PLC Rodrigues**, M Congedo. "Dataset of an EEG-based BCI experiment in virtual reality and on a personal computer". Research report. GIPSA-lab and IHMTEK. 2019. Report available at [hal-02078533](#)  .
- 23** G Cattan, **PLC Rodrigues**, M Congedo. "EEG Alpha Waves Dataset". Research report. GIPSA-lab. 2018. Report available at [hal-02086581](#)  .
- 24** L Korczowski, E Ostaschenko, A Andreev, G Cattan, **PLC Rodrigues**, et al. "Brain invaders solo versus collaboration: Multi-user P300-based brain-computer interface dataset". Research report. GIPSA-lab. 2019. Report available at [hal-02173958](#)  .