

# Joaquín Rapela

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## Education

### University of Southern California

**Department of Electrical Engineering** 2003—2010  
PhD in Electrical Engineering.

Advisors: Dr. Norberto M. Grzywacz (Neuroscience) and Dr. Jerry M. Mendel (Signal Processing)

**Neuroscience Graduate Program** 2001—2003  
Studies in Neuroscience.

**Department of Electrical Engineering** 2000—2003  
MS in Electrical Engineering.

### Universidad de Buenos Aires

“Licenciatura (equivalent to MS)” in Computer Science. 1995—1998

BS in Computer Science. 1992—1995

## Publications

Aishah Qureshi, Campagner Dario, Mitra Javadzadeh, **Rapela J.** (2022) *Tracking Freely Moving Mice Using Computer Vision, Statistical Inference and Statistical Learning Techniques*. 44th Annual International Conference of the IEEE Engineering in Medicine & Biology Society (EMBC) [one-page paper](#), [presented poster](#).

Javadzadeh M, **Rapela J.**, Sahani M., Hofer S.B. (2022, selected for oral presentation) *Dynamic causal communication channels between neocortical areas*. CoSyNe. [abstract](#).

**Rapela J.**, (2022) *Matrix differentials simplify the calculation of derivatives with respect to matrices..* [technical report](#).

**Rapela J.**, Todorov D. (accepted) *Hidden Markov models applied to LFPs from layer two and three of human cortex reveal highly stereotypical discrete states in epileptic seizures separated by more than an hour*. 2019 41st Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC). [article](#), [supplemental](#).

**Rapela J.**, Proix T., Todorov D., Truccolo W. (2019, selected for oral presentation) *Uncovering low-dimensional structure in high-dimensional representations of long-term recordings in people with epilepsy*. 2019 41st Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC). [IEEE EBMC](#), [preprint](#).

**Rapela J.**, Westerfield M., Townsend J. (2018) *A new foreperiod effect on single-trial phase coherence. Part I: existence and relevance*. *Neural Computation* 30(9):2348-2383. [Neural Computation](#), [preprint](#), [preprint supplemental](#) (3 citations).

**Rapela J.** (2018) *Traveling waves appear and disappear in unison with produced speech*. [preprint](#) (4 citations).

**Rapela J.** (2017) *Rhythmic production of consonant-vowel syllables synchronizes traveling waves in speech-processing brain regions*. [preprint](#) (2 citations).

**Rapela J.** (2016) *Entrainment of traveling waves to rhythmic motor acts*. [preprint](#) (2 citations).

**Rapela J.**, Kostuk M, Rowat, P.F., Mullen, T., Chang E.F., Bouchard K. (2015) *Modeling neural activity at the ensemble level*. [preprint](#).

**Rapela J.**, Gramann K., Westerfield M., Townsend J., & Makeig S. (2012). *Brain oscillations in Switching vs. Focusing audio-visual attention*. Proceedings of the 34th Annual International Conference of the IEEE EMBS, San Diego, California. (15 citations)

**Rapela J.**, Tsong-Yan L., Westerfield M., Jung T.P. & Townsend J., (2012). *Assisting autistic children with wireless EOG technology*. Proceedings of the 34th Annual International Conference of the IEEE

EMBS, San Diego, California. (14 citations)

**Rapela J.**, Felsen G., Touryan J., Mendel J.M., & Grzywacz N.M. (2010). *ePPR: a new strategy for the characterization of sensory cells from input/output data*. *Network: Computation in Neural Systems*. 21(1-2): 35-90. (15 citations)

**Rapela J.**, Mendel J.M., & Grzywacz N.M. (2006). *Estimating nonlinear receptive fields from natural images*. *Journal of Vision* 6(4), 441-474. (31 citations)

Shattuck D., **Rapela, J.**, Asma E., Chatziioannou A., Qi J., & Leahy R. (2002). *Internet2-based 3D PET Image Reconstruction using a PC Cluster*. *Physics in Medicine and Biology* 47, 2785-2795. (57 citations)

**Rapela J.** (2001). *Automatically Combining Ranking Heuristics for HTML Documents*. Proceedings of the Third International Workshop on Web Information and Data Management, 61-67, New York, NY: ACM Press. (18 citations)

## Academic Experience

### Gatsby Computational Neuroscience Unit University College London

June 2019—

**Position:** Research Engineer Fellow.

- ★ Distributes, performs quality control and enhances advanced statistical neuroscience algorithms developed at the Gatsby Computational Neuroscience Unit (e.g., [Sparse Variational Gaussian Processes Factor Analysis](#)) (keywords: sparse variational learning, Gaussian processes, nonlinear optimization, unsupervised learning, Python, continuous integration, Pytorch, SciPy, Plotly).
- ★ Collaborates with experimental neuroscientists at the Sainsbury Wellcome Centre on the use of advanced statistical algorithms for the characterization of neural populations electrophysiological recordings (keywords: [linear dynamical systems with external inputs](#), expectation maximization).
- ★ Contributes to the development of software infrastructure to record, store, manage and display large-scale continuous (24/7) behavioral and electrophysiological recordings from foraging mice (keywords: foraging, dashboard, interactive visualization, data acquisition, experimental control, Python, software development best practices).
- ★ As part of the Simons Collaborative on the Global Brain (SCGB) undergraduate research fellowship (SURF), with Dr. Mitra Javadzadeh No (Sainsbury Wellcome Centre), co-mentors Ms. Aishah Qureshi, undergraduate student from Queen Mary University of London ([more info](#)).
- ★ Trains members of the Gatsby Computational Neuroscience Unit and the Sainsbury Wellcome Centre in open-science tools (e.g., [Introduction to Python and Open-Science Tools](#), [Hands-On Tutorial on Code Testing for Researchers](#)).
- ★ Works with members of the Sainsbury Wellcome Centre and the Gatsby Computational Neuroscience Unit to improve the research culture of our workplace ([more info](#)).

### The Truccolo Lab for Computational Neuroscience Brown University

August 2017—January 2019

**Position:** Research Associate.

- ★ Discovered stereotypical discrete states in pre-ictal, ictal and post-ictal periods of seizures separated by more than one hour. This finding was obtained using micro-electrode array recordings from cortical layers two and three of persons with epilepsy (Rapela and Todorov, 2019) (keyword: epilepsy, unsupervised time-series modeling, hidden Markov models).
- ★ Found two-dimensional descriptors of high-dimensional representations of electrophysiological neural recordings from persons with epilepsy that separate well inter-ictal, pre-ictal, ictal and post-ictal periods. This finding was obtained using micro-electrode array recordings from cortical layers two and

three of persons with epilepsy (Rapela et al, 2019) (keywords: epilepsy, low-dimensional manifolds, t-SNE, XGBoost, multivariate logistic regression).

**Instituto en Luz Ambiente y Vision**  
**Universidad Nacional de Tucumán, Argentina**  
**Positions:** External researcher.

November 2013—Present

**Swartz Center for Computational Neuroscience**  
**University of California San Diego**  
**Positions:** Postdoctoral and visiting scholar,

November 2010—July 2017

- ★ Characterized spatio-temporal brain dynamics related to speech production from electrocorticographic neural recordings (Rapela 2016, 2017) (keywords: spatio-temporal dynamics, synchronization of oscillators, phase-amplitude coupling, phase coherence)
- ★ Principal investigator in the project *Taking the next step toward understanding computations by neural ensembles with high resolution neural recordings, generic data assimilation methods, and increased computational power* funded by the Center for Brain Activity Mapping, part of president's Obama B.R.A.I.N. initiative (Rapela et al., 2015) (keywords: population density models, dynamical systems)
- ★ Discovered a new effect of temporal expectation on the single-trial phase coherence of the electroencephalogram (EEG) using a variational Bayes linear regression method. (Rapela et al., 2018) (keywords: attention, expectation, EEG, time-frequency analysis, single trial analysis, variational-Bayes linear regression, pattern recognition and machine learning)
- ★ Found that switching attention between the visual and auditory modality generate transient arousal of attention in both modalities (Rapela, Gramman et al., 2012) (keywords: attention switch, EEGLAB, time-frequency analysis)
- ★ Developed a computer game controlled online by the eye movements of the player, recorded using electrooculography, and quantified the speed and accuracy of attention-orienting eye movements (Rapela, Line et al., 2012) (keywords: eye movements, EEG, EOG)

**University of Southern California**

**Position:** Research Assistant.

2001—2010

**Advisors:** Dr. Norberto M. Grzywacz. Director, Neuroscience Graduate Program. Professor, Department of Biomedical Engineering. Dr. Jerry Mendel. Professor, Department of Electrical Engineering.

- ★ Investigated Bayesian models to evaluate the optimality of retinal computations (keywords: Bayesian statistics, optimal neural codes).
- ★ Developed the Volterra Relevant Space Technique (VRST) for the estimation of spatial Volterra models of visual cells (Rapela et al., 2006) (keywords: Volterra models, dimensionality reduction, nonlinear systems, regression analysis)
- ★ Developed the extended Projection Pursuit Regression (ePPR) algorithm for the spatio-temporal characterization of visual cells from input/output data (Rapela et al., 2010) (keywords: projection pursuit regression, nonlinear optimization, dimensionality reduction)

**University of Southern California**

**Position:** Research Assistant.

August 2000—August 2001

**Advisor:** Dr. Richard M. Leahy. Professor, Department of Electrical Engineering.

- ★ Participated in the development of a distributed computing application for MAP reconstructions of 3D PET data, which was accessed remotely using a Java-based interface (Shattuck, Rapela, et al., 2002)
- ★ Research on methods for MEG/EEG source localization.

<b>Teaching Experience</b>	<b>University College London</b> <span style="float: right;">January 2023 –</span>
	<b>Course:</b> Neuroinformatics (NEURO019)
	<b>Role:</b> Teaching assistant
	<b>University College London</b> <span style="float: right;">November 2019, May 2021</span>
	<b>Course:</b> PyStarters
	<b>Role:</b> Instructor of Python programming
<b>Teaching Experience</b>	<b>Brown University</b> <span style="float: right;">September 2017—December 2017</span>
	<b>Course:</b> NEUR2110 Statistical Neuroscience
	<b>Role:</b> Teaching assistant
	<b>University of Southern California</b> <span style="float: right;">January 2009—May 2009</span>
	<b>Course:</b> EE 364: Introduction to Probability and Statistics for Electrical Engineering and Computer Science. Evaluations available upon request.
	<b>Role:</b> Discussion section leader.
<b>Teaching Experience</b>	<b>Universidad de Buenos Aires</b> <span style="float: right;">August 1999—December 1999</span>
	<b>Course:</b> Numerical Linear Algebra.
	<b>Role:</b> Teaching Assistant.
	<b>Universidad de Buenos Aires</b> <span style="float: right;">August 1998—August 1999</span>
	<b>Course:</b> Artificial Intelligence.
	<b>Role:</b> Teaching Assistant.
<b>Service</b>	<b>Vision Research, Frontiers in Neuroscience, Journal of Perceptual Imaging</b> Ad hoc reviewer.
<b>Funding</b>	<b>Biotechnology and Biological Sciences Research Council</b> <span style="float: right;">2023—2026</span> Co-investigator, grant BB/W019132/1 <i>Machine Intelligence for Neuroscience Experimental Control.</i>
	<b>Center for Brain Activity Mapping</b> <span style="float: right;">2013—2014</span> Principal investigator, grant 2013-023CBAM
<b>Selected Courses</b>	<b>University of Southern California</b> <b>Mathematics:</b> Topology, Fundamental Concepts of Analysis, Real Analysis (audited), Functional Analysis (audited). <b>Engineering:</b> Transform Theory for Engineers, Random Processes in Engineering, Introduction to Digital Signal Processing, Computational Solution to Optimization Problems, Information Theory, Statistics for Engineers. <b>Neuroscience:</b> Control and Communication in the Nervous System, Neurobiology, Advanced Neurosciences I, Advanced Neurosciences II.
<b>Industry Experience</b>	<b>IBM Almaden Research Center</b> <span style="float: right;">January 2000—August 2000</span> <b>Position:</b> Staff Software Engineer

Developed a Java interface for the Andrew File System, allowing users to securely access the file system over the Internet using servlets. Experience in distributed file systems.

**McLees, Argentina**

**Position:** Software Engineer

March 1999—September 1999

Participated in the development of a distributed object-oriented application in Java using CORBA and RMI.

**Alfanuclear, Argentina**

**Position:** Software Engineer

December 1998—March 1999

Medical Image software development in C++.

**Oracle, Argentina**

**Position:** Software Engineer

June 1998—September 1998

Constructed a web based application for purchasing gas station products through the Internet using Oracle tools: Oracle Web Application Server, Oracle Forms, and Oracle Designer 2000.

**IBM, Argentina**

**Position:** Fellowship holder

September 1997—June 1998

Technical consultant and programmer of Internet based applications.

**IBM Almaden Research Center**

**Position:** Fellowship holder

October 1996—September 1997

Migrated to Java IBM's storage solution ADSM. Experience in JDBC, native methods, user interface development in Java, and push technology.

**IBM, Argentina**

**Position:** Fellowship holder

April 1994—October 1996

Research on object persistence for the Object Oriented Software Group of IBM Argentina and development of object-oriented applications with VisualAge for Smalltalk. Construction of an image processing application performing optical character recognition on credit card receipts. Due to performance constraints this application used concurrent programming with shared memory for inter-process communication under AIX (IBM's UNIX).

**Programming Languages** R, Python, Matlab, Java, C/C++, Smalltalk, Pascal, Assembler.