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

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).
main article: https://sccn.ucsd.edu/~rapela/papers/Rapela_and_Todorov_EMBC_2019.pdf
supplementary information: https://sccn.ucsd.edu/~rapela/papers/embc19_hmm_supplemental.pdf

Rapela J., Proix T., Todorov D., Truccolo W. (accepted 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).
https://sccn.ucsd.edu/~rapela/papers/EMBC19_Rapela_et_al_IEEE_EMBC_2019.pdf
https://embs.papercept.net/conferences/conferences/EMBC19/program/EMBC19_ContentListWeb_3.html#thc02_02

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. (3 citations)

Rapela J. (2018) *Traveling waves appear and disappear in unison with produced speech.* https://arxiv.org/abs/1806.09559 (1 citation)

Rapela J. (2017) *Rhythmic production of consonant-vowel syllables synchronizes traveling waves in speech-processing brain regions.* https://arxiv.org/abs/1705.01615 (2 citations)

Rapela J. (2016) *Entrainment of traveling waves to rhythmic motor acts.* http://arxiv.org/abs/1606.02372 (1 citation)

Rapela J., Kostuk M, Rowat, P.F., Mullen, T., Chang E.F., Bouchard K. (2015) *Modeling neural activity at the ensemble level.* http://arxiv.org/abs/1505.00041

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. (13 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. (11 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. (13 citations)

Rapela J., Mendel J.M., & Grzywacz N.M. (2006). *Estimating nonlinear receptive fields from natural images*. Journal of Vision 6(4), 441-474. (29 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. (15 citations)

Academic Experience

Gatsby Computational Neuroscience Unit
University College London June 2019—
Position: Research Fellow.

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, submitted) (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, submitted) (keywords: epilepsy, low-dimensional manifolds, t-SNE, XGBoost, multivariate logistic regression).

Instituto en Luz Ambiente y Vision
Universidad Nacional de Tucumán, Argentina November 2013—Present
Positions: External researcher.

Swartz Center for Computational Neuroscience
University of California San Diego November 2010—July 2017
Positions: Postdoctoral and visiting scholar,

- ⋆ 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.

Teaching Experience

Brown University September 2017—December 2017
Course: NEUR2110 Statistical Neuroscience
Role: Graded homeworks and addressed questions from students related to course material.

University of Southern California January 2009—May 2009
Course: EE 364: Introduction to Probability and Statistics for Electrical Engineering and Computer Science. Evaluations available upon request.
Role: Discussion section leader.

Universidad de Buenos Aires August 1999—December 1999
Course: Numerical Linear Algebra.
Role: Teaching Assistant.

Universidad de Buenos Aires August 1998—August 1999
Course: Artificial Intelligence.
Role: Teaching Assistant.

Service

Vision Research, Frontiers in Neuroscience
Ad hoc reviewer.

Funding

Center for Brain Activity Mapping 2013—2014
Principal investigator, grant `2013-023CBAM`
Taking the next step toward understanding computations by neural ensembles with high resolution neural recordings, generic data assimilation methods, and increased computational power.

Selected Courses

University of Southern California
Mathematics: Topology, Fundamental Concepts of Analysis, Real Analysis (audited), Functional Analysis (audited). **Engineering:** Transform Theory for Engineers, Random Processes in Engineering, Introduction to Digital Signal Processing, Computational Solution to Optimization Problems, Information Theory, Statistics for Engineers. **Neuroscience:** Control and Communication in the Nervous System, Neurobiology, Advanced Neurosciences I, Advanced Neurosciences II.

Industry Experience

IBM Almaden Research Center
Position: Staff Software Engineer January 2000—August 2000
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 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.