PAOLA MALERBA

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Education

PhD, Mathematics, Boston University
Dissertation: *Excitation Dominated or Inhibition Dominated: different mechanisms behind rhythmic interaction in a hippocampal model*
Dynamical Systems of Brain Oscillations, 2010, Advisor: Prof. Nancy Kopell

Laurea *cum Laude*, Mathematics, Universitá degli Studi La Sapienza, Pisa, Italy
Dissertation: *Dynamical aspects of models of excitable membranes: the mathematical neuron* [Italian]
Dynamical Systems, 2005, Advisor: Prof. Stefano Marmi

Research Experience

Jan 2019 – May 2019: **Assistant Project Scientist in Neuroscience.**
Neural Dynamics and Behavior Lab, UC Irvine (P.I. Bruce McNaughton)

Sept 2017 – Dec 2018: **Assistant Project Scientist in Neuroscience.**
Sleep and Cognition Lab, UC Riverside/UC Irvine (P.I. Sara C. Mednick)

Sept 2013 – Aug 2017: **Research Associate/Assistant Project Scientist in Computational Neuroscience.**
Bazhenov Research Group, UC Riverside/UC San Diego (P.I. Maxim Bazhenov)

Sept 2010 – Aug 2013: **Research Associate in Neural Engineering.**
Neuronal Dynamics Lab, Brain Institute, University of Utah (P.I. John White)

May 2010 – Aug 2010: **Research Associate in Applied Mathematics.**
Center for Bio-Dynamics, Boston University (P.I. Nancy Kopell)

Publications

1. Komarov M., **Malerba P.**, Golden, R., Nunez P., Halgren E., Bazhenov M. *Selective Recruitment of Cortical Neurons by Electrical Stimulation.* Plos Comput Biol, 2019
2. **Malerba P.**, Rulkov N.F., Maxim B. *Large step discrete-time modeling of sharp-wave activity in hippocampal area CA3.* Accepted, Communications in Nonlinear Science and Numerical Simulation, 2019 doi: 10.1016/j.cnsns.2018.12.009
3. **Malerba P.,** Simons S.B., Whitehurst L., Mednick S*. Spatio-temporal structure of sleep slow oscillations on the electrode manifold and its relation to spindles.* Sleep, 2018 doi: 10.1093/sleep/zsy197
4. **Malerba P.**, Tsimring K., Bazhenov M. *Learning-induced sequence reactivation during sharp-wave ripples: a computational study*. in Research from 2017 Association for Women in Mathematics Symposium, Springer
5. **Malerba P.**, Bazhenov M. *Circuit mechanisms of hippocampal reactivation during sleep.* Neurobiology of Learning and Memory, 2018 doi: 10.1016/j.nlm.2018.04.018
6. **Malerba P.**, Straudi S, Fregni F, Bazhenov M, Basaglia N *Using Biophysical models to understand the effect of tDCS on neurorehabilitation: searching for optimal covariates to enhance post-stroke recovery.* Frontiers in Neurology, 2017 doi: 10.3389/fneur.2017.00058

7. **Malerba P.,** Krishan G.P., Fellous JM. and Bazhenov M. *Hippocampal CA1 Ripples as Inhibitory Transients.* PLOS Computational Biology, 2016. doi: 10.1371/journal.pcbi.1004880
8. Fernandez F., **Malerba P.**, and White J. *Non-linear membrane properties in entorhinal cortical stellate cells reduce modulation of input-output responses by voltage fluctuations.* PLOS Comput Biol, 2015 doi: 10.1371/journal.pcbi.1004188
9. Fernandez F., **Malerba P.**, Bressloff P. and White J. *Entorhinal stellate cells show preferred spike phase-locking to theta inputs that is enhanced by correlations in synaptic activity.* Journal of Neuroscience, 2013 doi: 10.1523/JNEUROSCI
10. Broicher T.*, **Malerba P.***, Dorval A., Borisyuk A., Fernandez F. and White J. *Spike Phase Locking in CA1 Pyramidal Neurons depends on Background Conductance and Firing Rate.* Journal of Neuroscience, 2012 doi: 10.1523/JNEUROSCI (*Shared First Authorship*)
11. **Malerba P.** and Kopell N. *Phase resetting reduces theta-gamma rhythmic interaction to a one-dimensional map.* Journal of Mathematical Biology, 2012 doi:10.1007/s00285-012-0534-9
12. Kopell N., Kramer M., **Malerba P.** and Whittington M. *Are different rhythms good for different functions?* Frontiers in Human Neuroscience, 2010 doi: 10.3389/fnhum.2010.00187
13. Kopell N., Borgers C., Pervouchine D., **Malerba P.** and Tort A. *Gamma and Theta Rhythms in Biophysical Models of Hippocampal Circuits.* In Hippocampal Microcircuits: A Computational Modelers Resource Book (V. Cutsuridis, B. Graham, S. Cobb, and I. Vida, eds.) Springer-Verlag (2010)
14. **Malerba P.** *Excitation Dominated or Inhibition Dominated: different mechanisms behind rhythmic interaction in a hippocampal model.* PhD Thesis Boston University, 2010

Under Review/ In Preparation

1. Malerba P., Whitehurst L., Mednick S.C. *Topography of sleep spindles suggests target oscillatory coupling events mediating memory consolidation for word pairs.* In preparation
2. Simon K.C., **Malerba P.**, Nakra N., Harrison A., Mednick S.C., Nagel M. *Slow oscillation rates decrease across development in Duchenne Muscular Dystrophy*. Submitted
3. Sanda P., **Malerba P.**, Jiang X., Krishnan G., Cash S., Halgren E., Bazhenov M. *Interaction of Hippocampal Ripples and Cortical Slow Waves leads to Coordinated Large-scale Sleep Rhythm.* bioRxiv, 2019, https://doi.org/10.1101/568881
4. Howe T., Jones M., Bazhenov M., **Malerba P.** *Loss of NMDA impairs ripple occurrence without altering ripple structure.* Submitted

Patents

Apparatus and methods for estimating an electrical stimulation effect on cortical neurons. [62573129] UCSD Office of Innovation and Commercialization. Primary Innovator: Maksim Bazhenov. With: Eric Halgren, Maxim Komarov and Paola Malerba. (2017)

Grants

Pending:

The complementary role of Global and Local Sleep Oscillations in memory. (multi-PI: Paola Malerba and Sara C. Mednick). NIMH Exploratory/Developmental Research Grant (R21) - **scored**

An interdisciplinary approach to the complementary role of Global and Local Sleep Oscillations in memory (PI-Paola Malerba) NIH New Innovator Award (D2) -**shortlisted for Stage 2 of Review (18% threshold)**

Understanding the sleep-cognition link in patients with DMD. (PI: Paola Malerba, Co-I Megan Waldrop). Muscular Dystrophy Association.

Neurophysiological sleep correlates of cognitive difficulties after concussion. (PI: Sean Rose, Co-PI: Paola Malerba). Neurology Internal Pilot Grant.

Novel analysis of analog EEG database of generalized epilepsy cohort. (PI: Paola Malerba, Co-PIs: David Greenberg, William Ray.) Pilot Award from OSU CCTS on use of Machine Learning and AI in translational research.

Sleep-dependent consolidation of hippocampal-dependent memory in children with DMD: pilot. (PI:Paola Malerba, Co-I Megan Waldrop). Pilot Award, Neurodevelopmental Research Affinity Group at RINCH

In preparation:

Role of Sleep in Neurorehabilitation after Stroke. (PI: Paola Malerba, coll: Sofia Straudi, MD PhD).

Teaching and Mentoring Experience

2020: Mentoring two high-school students from Metro school (Jan to May) on developing a research question
2019: Co-mentor in a K23 application by Dr. Lance Relland (PI Dr. Natalie Matrie) "EEG signatures of anesthesia effectiveness and consequences in babies and infants".
Mentored a rotation student (Oct to Dec) from the Biophysics Graduate Program at OSU.
2018: In-lab training on analysis of sleep EEG data. Mednick Sleep and Cognition Lab, UC Irvine.
College and Matrix Algebra (MA 116), Fall 2018. San Diego Mesa College
2014-17: In-lab training on Computational Neuroscience. Bazhenov Research Group, UC Riverside/UC San Diego
Guided Research Project for undergraduate student. (Modeling virtual rat exploratory behavior)
Guest Lectures: *Homeostatic Plasticity in Neural Networks*, UCSD biomedical sciences Graduate Program seminar (2017)
Understanding the dynamics of stroke neurorehabilitation: role of biophysical models, Translational Neuroscience Doctoral School Seminar, University of Ferrara Italy (2016)
Introduction to the role of sleep in memory consolidation. Cell Biology and Neuroscience Lab, UC Riverside (July 2015)
2012-13: In-lab Training on Computational Neuroscience. Neuronal Dynamics Lab, Brain Institute, University of Utah
2008: Calculus (MA 128) teaching assistant. Dep. of Mathematics and Statistics, Boston University

Honors and Awards

1. **Travel Grant** to attend and present at OCNS Computational Neuroscience meeting (2015)
2. **Travel Grant** to attend and present at OCNS Computational Neuroscience meeting (2014)
3. **Travel Grant** to attend and present at University of Pittsburgh meeting (2014)
4. **Travel Grant** to attend and present at FACM at NJIT (2013)
5. **Travel Grant** to attend and present at Hippocampal Research Conference (2011) from American Women in Mathematics – National Science Foundation (**AWM-NSF**)
6. **Graduate Student Presidential Fellowship**, (2005 to 2009), Boston University
7. INDAM **undergraduate scholarship** from INDAM (National Institute of High Mathematics, Rome) (2000)
8. Admission in Biological Sciences and Mathematics at the **Scuola Normale Superiore di Pisa**, STEM disciplines (2000)

Invited Talks (selected)

1. *Tba*, Chronic Brain Injury Discovery Program, The Ohio State University (Apr 2020)
2. *Sleep to remember: mechanisms linking sleep oscillations to memory consolidation,* Mathematical Bioscience Institute, The Ohio State University (Oct. 2019)
3. *Sleep to remember: mechanisms linking sleep oscillations to memory consolidation,* Battelle Center for Mathematical Medicine **Abigail Wexner Research Institute at Nationwide Children's Hospital** (Feb 2019)
4. *Sleep to remember: mechanisms linking sleep oscillations to memory consolidation,* BioEngineering Department at **University of Illinois at Urbana-Champaign** (Dec 2018)
5. *Sleep to remember: mechanisms linking sleep oscillations to memory consolidation,* Biology and Computer Science Colloquium at **University of Manitoba** (Nov 2018)
6. *Sleep to remember: mechanisms linking sleep oscillations to memory consolidation*, Mathematics Department at **University of Georgia** (Nov 2018)

7. *Asleep to remember: the role of sleep in memory*, **Innovation Research Lab** at San Diego Mesa College (Nov 2018)
8. *Sharp-wave ripples and hippocampal replay: modeling studies*, **Bernstein Conference 2018**, Berlin – in workshop: "Offline hippocampal activity: Neural sequences and sharp-wave ripples" – (Sept. 2018)
9. *Circuit mechanisms of hippocampal reactivation during sleep*, **MURI review at UC San Diego** (Dec. 2017)
10. *Mechanisms of hippocampal replay during sleep* **Association of Women in Mathematics (AWM) Research Symposium 2017** – in workshop on "Biological Oscillations Across Time Scales" (April 2017)
11. *Hippocampal Ripples as Inhibitory Transients*. In **Workshop: Cortical Oscillations at Annual Computational Neuroscience Meeting CNS 14,** Quebec City, Canada (July 2014)
12. *Sub- to supra-threshold dynamics determines firing rate sensitivity to additive noise.* **FACM '13 at New Jersey Institute of Technology, Newark, NJ** (May 2013)
13. *Mechanisms of spike phase locking to ongoing oscillations in a network model and single cells.* **UC Riverside, CA** (May 2013)
14. *Biophysics of spike timing in single neurons: examples of actively changing input-output properties in response to global changes in activity.* **Laboratory of Biological Modeling at NIH**, Washington, DC (Feb. 2013)
15. *Biophysics of spike timing in single neurons: examples of actively changing input-output properties in response to global changes in activity.* **University of Washington, Department of Mathematics**, Seattle, WA (Feb. 2013)
16. *Modeling rhythms contributes to understand neural networks dynamics.* **Spring Hippocampal Research Conference, Verona, Italy** (May 2011)
17. *Excitation dominated or inhibition dominated: Different mechanisms behind rhythmic interaction in a hippocampal model.* **University of Utah, dept. of Bioengineering**, Salt Lake City, UT (Jan. 2010)
18. *Mechanisms of theta-gamma interaction in the hippocampus.* **INRIA, Versailles**, France (Jan. 2009)
19. *Dynamical Mechanisms underlying the interaction of brain oscillations.* **University of Bristol, Department. of Engineering Mathematics**, Bristol, UK (Jan. 2009)

Abstracts (selected)

1. K. Simon, P. Malerba, N. Nakra, A. Harrison, S. Mednick, M. Nagel. Sleep physiology across development in Duchenne Muscular Dystrophy Disorder. World Sleep Conference 2019 and Tenth Biennial Conference on Pediatric Sleep Medicine (2019)
2. P. Malerba, L. Whitehurst, S. Mednick. *Spatio-temporal dynamics of sleep EEG rhythms and memory performance.* 2018 International Conference on Learning and Memory, Huntington Beach, CA (2018)
3. P. Malerba, S. Nagl, JM. Fellous, M. Bazhenov. *Reactivation of interfering memories in the hippocampus shapes memory performance: a computational study.* Society for Neuroscience Annual Meeting 2017, Washington DC (2017)
4. P. Sanda, P. Malerba, G. Krishnan, M. Bazhenov. *Multiple roles of hippocampal sharp wave - ripples in coordinating cortical slow waves.* Society for Neuroscience Annual Meeting 2017, Washington DC (2017)
5. M. Komarov, P. Malerba, E. Halgren, M. Bazhenov. *Selective activation of cortical neurons by extracellular electrical stimulation.* Society for Neuroscience Annual Meeting 2017, Washington DC (2017)
6. P. Malerba, A. Fodder, M. Jones, M. Bazhenov. *Modeling of coordinated sequence replay in CA3 and CA1 during sharp wave-ripples.* Society for Neuroscience Annual Meeting 2016, San Diego, CA (2016)
7. S. Nagl, B. Harper, P. Malerba, M. Bazhenov, JM. Fellous. *Neurophysiological Correlates of the Influences of Spatial Context on Hippocampal Reactivation in a Rodent Reconsolidation Paradigm.* SfN Annual Meeting 2016, San Diego, CA (2016)
8. M. Komarov, P. Malerba, E. Halgren, M. Bazhenov. *Estimation of the effect of electrical stimulation on cortical tissue.* Society for Neuroscience Annual Meeting 2016, San Diego, CA (2016)
9. P. Sanda, P. Malerba, G. Krishnan, M. Bazhenov. *Precise Ripple Timing affects Spatio-Temporal pattern of sleep slow oscillations in a Model of Memory Consolidation.* SfN Annual Meeting 2016, San Diego, CA (2016)
10. P. Malerba, G. Krishnan, M. Bazhenov. *Mechanisms of Hippocampal Sequence Replay.* BMC Neuroscience 2015 16(Suppl 1):P11 doi: 10.1186/1471-2202-16-S1-P11 (2015)
11. P. Malerba, S. Nagl, G. Krishnan, JM. Fellous, M. Bazhenov. *Understanding the mechanisms of hippocampal reactivation: from CA3 to CA1.* SfN Annual Meeting 2015, San Diego, CA (2015)
12. P. Sanda, P. Malerba, G. Krishnan, M. Bazhenov. *Interactions between cortical slow oscillations and hippocampal sharp-wave ripples during slow wave sleep.* SfN Annual Meeting 2015, San Diego, CA (2015)

13. P. Malerba, G. Krishnan, M. Bazhenov. *Hippocampal Ripples as Inhibitory Transients.* SfN Annual Meeting 2014, Washington, DC (2014)
14. P. Malerba, G. Krishnan, M. Bazhenov. *Hippocampal replay and cortical slow oscillations: a computational study.* BMC Neuroscience 2014 15(Suppl 1):P218 doi: 10.1186/1471-2202-15-S1-P218 (2014)
15. P. Malerba, G. Krishnan, M. Bazhenov. *Mechanisms of ripple generation and sequence repetition in the hippocampus.* Nonlinear Dynamics and Stochastic Methods Meeting, Pittsburgh, PA (2014)
16. P. Malerba and N. Kopell. *Two modes of theta-gamma interaction in a biophysical model of the hippocampus.* Society for Industrial and Applied Mathematics (SIAM) conference on Applications of Dynamical Systems, Snowbird, UT (2009)

Journals Refereed

PLOS Computational Biology; PLOS One; Cerebral Cortex; Journal of Computational Neuroscience, Cognition and Computation; Neural Networks, Journal of Theoretical Biology. *Review Editor at Frontiers in Human Neuroscience (Dec 2019 – present)*