Lorenzo Fontolan, Ph.D.

Computational Neuroscientist

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JANELIA RESEARCH CAMPUS - 19700 Helix Dr, Ashburn, VA 20147

Summary

I am a Computational Neuroscientist with a background in Physics and significant experience in **mathematical and computational modeling, machine learning, problem solving and data analysis.** Currently I am a research scientist in the lab of Dr. Sandro Romani where, in collaboration with the experimental lab of Dr. Karel Svoboda, I investigated the brain mechanisms behind **decision-making and motor preparation**. I am interested in understanding the **neural basis and the evolution of intelligent behavior** in animals and humans, hoping that a better understanding of our nature will lead to a more compassionate and just society.

Skills

Programming Skills: *Python, Matlab, C, XPP*

Other: *Dynamical Systems, Neuroscience, Statistics, Machine Learning, Statistical Physics, Neural networks, Theano, Tensorflow.*

Research experience

Janelia Research Campus – HHMI | Research Scientist [October 2021-present]

Janelia Research Campus – HHMI | Research Associate [2015 – September 2021]

- Built **computational models** of short-term memory, challenging long-standing hypotheses on the role of slow neural timescales during decision-making, and demonstrating that, during **short-term memory** tasks, cortical activity in frontal cortex is attracted towards a particular set of spike rate patterns, called discrete attractors, that predict the specific future action (published in **Nature**).
- Trained **artificial neural networks** to reveal how information is communicated across brain regions. Uncovered the neural mechanisms that allow short-term memories to persist and to repel potential sensory interference (published in **Nature Neuroscience**).

I presented my work at several leading conferences in the Neuroscience field (Sfn, Cosyne, HHMI) and organized introductory courses to Computational Neuroscience at Janelia Research Campus.

ENS Paris – University of Geneva | Ph.D. in Neuroscience [2011 – 2015]

- Developed and tested a state-of-the-art **biophysical model** of speech perception in cortical circuits
- Analyzed **brain recordings** from human patients. Combining both the modelling and the data analysis approaches enabled us to identify the role of brain rhythms in **speech perception**.
- Carried out the **mathematical analysis** of a simplified spiking neuron model

Published in: **Nature Communications**, **eLife**, **Trends in Neuroscience** and **Journal of Mathematical Neuroscience**.

Center for Theoretical Neuroscience – Columbia University | Exchange student [2009 – 2010]

- Employed computational and mathematical tools to study how to efficiently store and retrieve **correlated memories** in Hopfield networks (M.Sc. thesis work: "*Learning of hierarchical memories with binary synapses*")

Education	**Ph.D. in Neuroscience** (2011 - 2015, University of Geneva)

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Ph.D. in Neuroscience (2011 - 2015, University of Geneva)

Advisors: Prof. Anne-Lise Giraud and Prof. Boris Gutkin – Thesis title: "Encoding speech through brain rhythms"

M.Sc. in Physics *summa cum laude* (2008-2011, La Sapienza University of Rome)

Concentration: Dynamical systems and statistical physics. Advisors: Prof. Stefano Fusi (Columbia University of New York), Prof. Enzo Marinari – Thesis title: "Learning of hierarchical memories with binary synapses"

B.Sc. in Physics (2004-2007, La Sapienza University of Rome)

Concentration: Condensed matter physics. – Thesis title: "Infrared Reflectance of V_2O_3 Crystal"

Publications

Google scholar page: https://scholar.google.com/citations?user=01jqJYoAAAAJ&hl=en
ORCID: https://orcid.org/0000-0002-1566-6636 — h-index = 7, i-index = 7, >800 citations

1. Neural algorithms and circuits for motor planning. **Annu. Rev. Neurosci.** (2022)

2. Attractor dynamics gate cortical information flow during decision-making. **Nat. Neurosci.** (2021)

3. Discrete attractor dynamics underlying selective persistent activity. **Nature** (2019)

4. Θ-band and β-band neural activity reflects independent syllable tracking and comprehension of time-compressed speech. **J. Neurosci.** (2018)

5. Neural cross-frequency coupling: from mechanism to function. **Trends Neurosci.** (2015)

6. Speech encoding by coupled cortical theta and gamma oscillations. **eLife** (2015)

7. The contribution of frequency-specific activity to hierarchical information processing in the human auditory cortex. **Nat. Commun.** (2014)

8. Analytical insights on theta-gamma coupled neural oscillators. **J. Math. Neurosci.** (2013)

Talks and awards

Talks and seminars: NYU, Brandeis U., U. of Oregon, Rice Univ., ENS Paris, U. of Marseille, IDIBAPS Barcelona, U. of Geneva, U. of Padova, NJIT, Sfn Annual Meeting Washington DC, ICMN France, Bernstein symposium

Best PhD thesis in Neuroscience, 2015 Amicitia Excellence Prize (10,000 CHF)

Study abroad scholarship, 2009 La Sapienza University of Rome (4,000 EUR)

Teaching, mentoring & academic services

2021	**Organizer,** Bernstein symposium "Control mechanisms for contextual computations and behavior"
2021	**Mentor,** Neuromatch academy 2021
2020	**Content Reviewer**, Neuromatch academy 2020
2019	**Organizer and lecturer**, Mathematical Methods for Neuroscience and ML @Janelia
2019	**Speaker**, Venice Summer School in Computational and Theoretical Models in Neuroscience
2017 – 2019	**Lecturer**, Introduction to Computational Neuroscience Undergraduate Seminar @Janelia
2018	**Invited Lecturer**, General Philosophy course (Catholic University of America).
2017	**Attendee,** Scientists Teaching Science course (NIH)
2017	**Co-creator,** exhibition on AI and Neuroscience "WHAT? Machines that learn"
2016	**Attendee,** Methods in computational neuroscience course, MBL, Woods Hole, MA.
2015	**Mentor and Thesis Supervisor,** "Isomorphism of Hopfield nets and Ising model", B. Sc. in Physics, La Sapienza University of Rome
2006 – 2009	**Tutor**, college and high school physics and mathematics
Reviewer for:	*Nat. Neurosci., Neuron, PNAS, Physical Review X, Plos Comp. Biol., Cortex, Commun. Biol., Comput. Biol. Med., Lang., Cogn. Neurosci., Neurons behav. data anal. theory*

Languages

Italian, English, French and Spanish.