

Pietro Vertechi

Curriculum Vitae

Experience

2020–2022 **Researcher**, VEOS DIGITAL, Milan, Research and software development in Artificial Intelligence, data analysis, and mathematical modeling.

Education

2015–2020 **International Neuroscience Doctoral Programme**, MAINEN LAB, *Champalimaud Center for the Unknown*, Lisbon, Design behavioral assets and video games to test inference of latent variables in rodents and humans. Develop and apply topology and category theory-based tools to decode representation of task space in artificial and biological agents.

2014 **Internship**, MACHENS LAB, *Champalimaud Center for the Unknown*, Lisbon, Research project on biologically plausible learning rules in recurrent neural networks, with a focus on population coding and short-term memory.

2011–2013 **Last year of undergraduate studies (L3) and Master in Fundamental Mathematics**, *Ecole Normale Supérieure - UPMC Paris VI*, Paris, Mention Très Bien.

2011 **Awarded the Ecole Normale Supérieure International Selection Scholarship**, Paris.

2009–2011 **Undergraduate studies in Mathematics**, *Scuola Normale Superiore*, Pisa.

Master's Thesis

Title An ∞ -categorical approach to weak algebraic structures, with applications in derived algebraic geometry.

Supervisor Professor Gabriele Vezzosi

Participation in conferences

Neuroscience and Machine Learning

March 2018, Salt Lake City **Computational and Systems Neuroscience (Cosyne)**, *Talk*.

March 2017, Salt Lake City **Computational and Systems Neuroscience (Cosyne)**, *Poster*.

Nov. 2016, San Diego **Society for Neuroscience (SFN)**, *Poster*.

March 2016, Salt Lake City **Computational and Systems Neuroscience (Cosyne)**, *Poster*.

Dec. 2014, **Neural Information Processing Systems (NIPS)**, *Spotlight poster*.
Montreal

Mathematics

Nov. 2019, **Computational Topology and Neural Networks**, *Talk*.
Seville

March-June 2013, **Cycle of seminars on Derived Algebraic Geometry**, *Talk*.
Paris

Programming

July 2020, **JuliaCon 2020**, *Lightning talk*.
Virtual

August 2018, **JuliaCon 2018**, *Lightning talk*.
London

Organized workshops

July 2016, **Hierarchical Processing Advanced Course**, *Co-organizer*.
Lisbon

Publications

- 2022 Vertechi, Pietro (2022). “Dependent Optics”. In: *arXiv preprint arXiv:2204.09547*.
Vertechi, Pietro and Mattia G Bergomi (2022). “Machines of finite depth: towards a formalization of neural networks”. In: *arXiv preprint arXiv:2204.12786*.
- 2021 Bergomi, Mattia G, Massimo Ferri, Pietro Vertechi, and Lorenzo Zuffi (2021). “Beyond topological persistence: Starting from networks”. In: *Mathematics* 9.23, p. 3079.
- 2020 Bergomi, Mattia G and Pietro Vertechi (2020). “Rank-Based Persistence”. In: *Theory and applications of categories* 35.9, pp. 228–260.
- Brendel, Wieland, Ralph Bourdoukan, Pietro Vertechi, Christian K. Machens, and Sophie Denève (Mar. 2020). “Learning to Represent Signals Spike by Spike”. en. In: *PLOS Computational Biology* 16.3, e1007692. ISSN: 1553-7358. DOI: 10.1371/journal.pcbi.1007692.
- Vertechi, Pietro, Patrizio Frosini, and Mattia G Bergomi (2020). “Parametric machines: a fresh approach to architecture search”. In: *arXiv preprint arXiv:2007.02777*.
- Vertechi, Pietro, Eran Lottem, Dario Sarra, Beatriz Godinho, Isaac Treves, Tiago Quendera, Matthijs Nicolai Oude Lohuis, and Zachary F. Mainen (Apr. 2020). “Inference-Based Decisions in a Hidden State Foraging Task: Differential Contributions of Prefrontal Cortical Areas”. en. In: *Neuron* 106.1, 166–176.e6. ISSN: 0896-6273. DOI: 10.1016/j.neuron.2020.01.017.
- 2018 Lottem, Eran, Dhruva Banerjee, Pietro Vertechi, Dario Sarra, Matthijs oude Lohuis, and Zachary F. Mainen (Dec. 2018). “Activation of Serotonin Neurons Promotes Active Persistence in a Probabilistic Foraging Task”. en. In: *Nature Communications* 9.1. ISSN: 2041-1723. DOI: 10.1038/s41467-018-03438-y.

- 2014 Vertech, Pietro, Wieland Brendel, and Christian K Machens (2014). "Unsupervised Learning of an Efficient Short-Term Memory Network". In: *Advances in Neural Information Processing Systems 27*. Ed. by Z. Ghahramani, M. Welling, C. Cortes, N. D. Lawrence, and K. Q. Weinberger. Curran Associates, Inc., pp. 3653–3661.

Languages

Italian	Mothertongue
French	Fluent
English	Fluent
Portuguese	Fluent

CPE 2009

Additional skills

Programming languages Experience with Julia, Python, and Matlab.

Software development Developed and contributed to Julia packages for data manipulation (StructArrays.jl, IndexedTables.jl, and JuliaDBMeta.jl) and visualization (Interact.jl and AlgebraOfGraphics.jl).

Awards

- 2007 1st place in the Italian Mathematical Olympiad and 4th place ex aequo in the International Mathematical Olympiad (IMO 2007).

Other activities

- 2006–2007 **Fair Trade Volunteer**, Ass. *La Vita Nova*, Rome.
2018 **Google Summer of Code**.