










Demetrio Ferro

Curriculum Vitae

Personal information

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Website(s)          

Current status

PostDoctoral researcher

Field of Expertise: Computational & Cognitive Neuroscience, Information Theory.

I work in the group of Theoretical and Computational Neuroscience (TCN), within the Center for Brain and Computation (CBC) at the Department of Engineering of Information and Communication Technologies (ETIC), at the University Pompeu Fabra (UPF). My personal interest is to investigate the connections between the physiology of neural interactions and the computational rules involved with sensory information processing, transmission and storage towards the aim of achieving cognitive and behavioral goals. Both for the interest in inspecting how does the brain achieve its outstanding functions, and for my personal deep passion for science and technological innovation, I aim to expand my professional profile by conducting scientific research at interdisciplinary level.


Education and skills

Scientific Background Academic knowledge of cognitive neuroscience with focus on neurophysiological interactions and functional connectivity at intracortical level. General background in structural/functional neuroanatomy and physiology of cognitive neural functions. The most recent research experiences concern computational modelling of neural physiological circuitry for visual processing and attention, yielding insights about the spectral features of neural cortical signals and their interactions within and between neocortical brain areas. My scientific background includes solid basis in mathematics, information processing and transmission theory (Advanced Mathematical Analysis, Statistics and Probability Theory, Signal Processing, Source/Channel Coding, Stochastic Processes, Graph Theory, Network and Queuing Theory, Causality and Auto-Regressive modelling). Background in Digital Communications Systems both theoretical and applied. Involved in many data science projects, including both recent techniques based on Artificial Neural Networks and classical Bayesian Estimation theory providing published results both in computational and in life sciences. Expertise was supplied with practice in the use and development of main ICT technologies and modelling software for numerical simulation.

Languages  Italian : *C2*;  English: *C1*;  French: *B2*;  Spanish: *B2* (CEFR Levels).

Technical skills	Proficient knowledge of hardware and software computer architecture and skills of assembly systems for general or specific purpose. Daily use of MATLAB (since ~ 15 years), Python, and integrated solutions combining numerical simulation and operating system both in Windows and Linux Environment. Skilled in graphical editing and Graphical User Interface development both system integrated and in object-oriented framework (e.g. Matlab GUIs). Advanced experience of Microsoft Windows operating system and advanced experience of Linux operating system, multi-processing and multi-threading programming. Approaching cloud computing, consolidating repository maintenance skills.
Software skills	MATLAB, Matlab GUI, Python, Jupyter Notebook, Conda, Rstudio, Github, Microsoft Visual Studio, Eclipse IDE, CodeBlocks, Netbeans, Wireshark, Microsoft Office Suite, TexMaker, Adobe Photoshop, Adobe Illustrator, Inkscape, GNU Emacs, Vi/Vim.
Software languages	MATLAB, R, Python, Ruby, JAVA, C, C++, HTML, CSS, Javascript, VHDL, SQL, BASH, \LaTeX , O.S. Unix, Windows. DataBase MySQL, Oracle.
Certificates	<ul style="list-style-type: none"> (i) Preliminary Englis Test, Cambridge ESOL (2007); (ii) International Computer Driving Licence (2008); (iii) European Computer Driving Licence Advanced (2009); (iv) Coursera - Medical Neuroscience, Prof. Leonard E. White, Duke University; (v) Coursera - Machine Learning, Prof. Andrew Ng, Stanford University.
Repository	Data and code from published material and related tools developed: Gin G-Node .

Academic path

2016-2019 **Ph.D. Degree in Cognitive Neuroscience** ,
University of Trento, Rovereto, IT

Advisor: Prof. Stefano Panzeri (previously at *CNCS@IIT, Rovereto, IT*), in collaboration with Prof. Alexander Thiele (*Univ. of Newcastle, Newcastle upon Tyne, UK*).


Thesis: Effects of attention on visual processing between cortical layers and cortical areas V1 and V4 (iris.unitn.it). Study of the effects of attention on Local Field Potential (LFP) signals across multiple laminar depths in cortical areas V1 and V4. The thesis first approaches the investigation of LFP spectral properties at different behaviorally relevant time windows, then focuses on the effects of attention on signal spectral features. The investigation of signal properties is carried further by considering the analysis of Shannon Mutual Information conveyed by cortical LFPs about attended visuospatial variables. Finally, the study conveys to the analysis of laminar circuits and their functional connectivity by the analysis of causal signal propagation among different depths within and between visual areas.

2013-2015 **M.Sc. Degree in Telecommunication Engineering** ,
Polytechnic of Turin, Turin, IT

(*cum laude*)

Advisors: Prof. Guido Montorsi (*Polytechnic of Turin, Turin, IT*), Prof. Claude Berrou and Vincent Gripon, PhD (*T  l  com Bretagne, Brest, FR*).

Thesis: Nearest Neighbour Search using binary clustered Neural Networks. (**Abstract**). Introduction of a peculiar solution to highly dimensional Nearest Neighbour search. The aim is to access to data of interest with a smart strategy and in reduced time (reduction could be as large as $\sim 77\%$). The thesis experiments a technique which has a neuro-inspired approach. Neural Networks are trained over a coarse-grained version of the data, then refined by a softer, fine-grained quantization stage. Performances and cost are compared to the equivalent state-of-the art techniques.

2009-2013 **B.Sc. Computer Engineering Degree** ,
Università degli Studi di Salerno, Salerno, IT

Advisors: Prof. Stefano Marano and Prof. Vincenzo Matta (*Univ. of Salerno, Salerno, IT*).

Thesis: Information Flows hidden in network traffic: analysis of embedding policies.

The work discusses the capability of detecting embedded network packets under cover traffic in order to rely hidden informations to specific network nodes. The analytical study was supplied by derivation of known results for bidirectional links, followed by simulations showing the match between the implementation of the relative algorithms and theoretical results.

Research path

- Oct 2020 **PostDoctoral researcher - Universitat Pompeu Fabra** ,
current *Dept. of Engineering and Information Technologies (ETIC),
Teoretical and Computational Neuroscience (TCN), Barcelona, ES.*
Lab head: Prof. Rubén Moreno-Bote
- Nov 2019 **Internship at CNCS - Italian Institute of Technology,**
Aug 2020 *Center for Neuroscience and Cognitive Systems, Rovereto, Trento, IT*
Lab head: Prof. Stefano Panzeri.
- Apr 2016 **Internship at CNCS - Italian Institute of Technology,**
Sep 2016 *Center for Neuroscience and Cognitive Systems, Rovereto, Trento, IT*
Lab head: Prof. Stefano Panzeri.
- Apr 2015 **M.Sc. Thesis at NeuCod - Télécom Bretagne** ,
Sep 2015 *Neural Coding group, Brest, Bretagne, France*
Advisor: Prof. Claude Berrou, Co-advisor: Vincent Gripon, PhD.
- Oct 2012 **B.Sc. Thesis at CoRiTel - Ericsson,**
Mar 2013 *Research Consortium on Telecommunications, Fisciano, Salerno, IT*
Advisors: Prof. Stefano Marano and Prof. Vincenzo Matta.

Teaching & supervising

- 2021-2023 **Scientific Communication, (3 ECTS credits),**
Universitat Pompeu Fabra, Faculty of Biomedical Engineering.
- July 2023 **Internship supervisor, Student: Pau Garriga Marsans,**
Aug 2023 *Universitat Pompeu Fabra, Faculty of Biomedical Engineering.*
- Sept 2023 **Internship supervisor, Student: Marcel Socoró Garrigosa,**
Nov 2023 *Universitat Pompeu Fabra, Faculty of Biomedical Engineering.*
- Sept 2023 **Thesis supervisor, Student: Pau Boncompte Carre,**
2024 *Universitat Pompeu Fabra, Faculty of Biomedical Engineering.*

Publications

- NComms 2024 **D. Ferro, T. Cash-Padgett, M. Z. Wang, B. Hayden and R. Moreno-Bote, “Gaze-centered gating, reactivation, and reevaluation of economic value in orbitofrontal cortex”,** Nature Communications, 15(6163), July 2024. DOI: [10.1038/s41467-024-50214-2](https://doi.org/10.1038/s41467-024-50214-2).

- CCN 2023 **D. Ferro**, Anna Rifé, T. Cash-Padgett, M. Z. Wang, B. Hayden and R. Moreno-Bote, “*The role of gaze for value encoding and recollection in orbitofrontal cortex*”, Conference on Cognitive Computational Neuroscience, Oxford, August 2023. DOI: [10.32470/CCN.2023.1122-0](https://doi.org/10.32470/CCN.2023.1122-0).
- HPB KG 2023 **D. Ferro**, B. Hayden and R. Moreno-Bote, “*Model of gaze centred activation and reactivation of value encoding in orbitofrontal cortex*”, Human Brain Project [Knowledge Graph](#), 2023.
- bioRxiv 2023 **D. Ferro**, T. Cash-Padgett, M. Z. Wang, B. Hayden and R. Moreno-Bote, “*Gaze-centered gating and re-activation of value encoding in orbitofrontal cortex*”, bioRxiv, April 2023. DOI: [10.1101/2023.04.20.537677](https://doi.org/10.1101/2023.04.20.537677).
- PNAS 2021 **D. Ferro**, J. van Kempen, M. Boyd, S. Panzeri and A. Thiele, “*Directed information exchange between cortical layers in macaque V1 and V4 and its modulation by attention.*”, Proceedings of the National Academy of Sciences, 118(12), March 2021. DOI: [10.1073/pnas.2022097118](https://doi.org/10.1073/pnas.2022097118).
- bioRxiv 2020 **D. Ferro**, J. van Kempen, M. Boyd, S. Panzeri and A. Thiele, “*Directed information exchange between cortical layers in macaque V1 and V4 and its modulation by attention.*”, bioRxiv, June 2020. DOI: [10.1101/2020.06.09.142190](https://doi.org/10.1101/2020.06.09.142190).
- IRIS 2020 **D. Ferro**, “*Effects of attention on visual processing between cortical layers and cortical areas V1 and V4.*”, PhD Thesis published in Academic Institutional Research Information System (IRIS), Dec. 2019. DOI: [10.15168/11572_246290](https://doi.org/10.15168/11572_246290).
- IJCNN 2016 **D. Ferro**, V. Gripon, and X. Jiang. “*Nearest neighbour search using binary neural networks.*”, International Joint Conference on Neural Networks (IJCNN). IEEE, July 2016. DOI: [10.1109/IJCNN.2016.7727873](https://doi.org/10.1109/IJCNN.2016.7727873).

Abstracts & Talks

- ICT 2024 **D. Ferro**, T. Cash-Padgett, M. Z. Wang, B. Y. Hayden, R. Moreno-Bote, (Talk) “*Economic decision-making in the brain: how does gaze relate to the activity of orbitofrontal cortex neurons?*”, ICT2024, June 2024 (Milan, IT).
- ICT 2024 R. Moreno-Bote, **D. Ferro**, J. Ramirez-Ruiz, (Poster) “*Theories of intrinsically motivated behavior: comparing Empowerment, Free Energy Principle and Maximum Occupancy Principle*”, ICT2024, June 2024 (Milan, IT).
- CCN 2023 **D. Ferro**, A. Rifé-Mata, T. Cash-Padgett, M. Z. Wang, B. Y. Hayden, R. Moreno-Bote, (Poster) “*The role of gaze for value encoding and recollection in orbitofrontal cortex*”, CCN, August 2023 (Oxford, UK).
- HBP WP2 **D. Ferro**, A. Rifé-Mata, T. Cash-Padgett, M. Z. Wang, B. Y. Hayden, R. Moreno-Bote, 2023 (Talk) “*Gaze-centered gating and re-activation of value encoding in orbitofrontal cortex*”, Human Brain Project Work Package 2 Meeting, June 2023 (Barcelona, ES).
- HPB Summit 2023 **D. Ferro**, A. Rifé-Mata, T. Cash-Padgett, M. Z. Wang, B. Y. Hayden, R. Moreno-Bote, (Poster) “*Looking at previous cue sites reactivates value coding for serial evaluation in orbitofrontal cortex*”, Human Brain Project Summit 2023, March 2023 (Marseille, FR).
- MSBFIINE 2022 **D. Ferro**, A. Rifé-Mata, T. Cash-Padgett, M. Z. Wang, B. Y. Hayden, R. Moreno-Bote, (Talk) “*Recalling what was there: Eye position in reward gambling and the role of orbito-frontal cortex in encoding the value of visually cued offers*”, MSBFIINE, Dec 2022 (Varenna, IT).

- Barccsyn 2022 **D. Ferro**, A. Rifé-Mata, T. Cash-Padgett, M. Z. Wang, B. Y. Hayden, R. Moreno-Bote, (Poster) “*Imagining what was there: Looking at an absent offer location modulates neural response in orbito-frontal cortex.*”, Barccsyn, May 2022 (Barcelona, ES).
- Cosyne 2022 **D. Ferro**, A. Rifé-Mata, T. Cash-Padgett, M. Z. Wang, B. Y. Hayden, R. Moreno-Bote, (Poster) “*Imagining what was there: Looking at an absent offer location modulates neural response in orbito-frontal cortex.*”, Cosyne, March 2022 (Lisbon and Cascais, PT).
- COREDEM 2021 (Talk) **D. Ferro**, A. Rifé-Mata, T. Cash-Padgett, M. Z. Wang, B. Y. Hayden, R. Moreno-Bote, “*Imagining what was there: Looking at an absent offer location modulates neural response in orbito-frontal cortex.*”, COREDEM (Human Brain Project, Work Package 2), Nov. 2021 (Barcelona, ES).
- SINC² 2021 **D. Ferro**, A. Rifé-Mata, T. Cash-Padgett, M. Z. Wang, B. Y. Hayden, R. Moreno-Bote, (Poster) “*Is your gaze your aim? Eye position in reward gambling [...] in encoding the value of visually cued offers.*”, Spanish Network for the Interaction between Computational and Cognitive Neuroscience (SINC²), Nov. 2021 (Lleida, ES).
- SENC 2021 **D. Ferro**, A. Rifé-Mata, T. Cash-Padgett, M. Z. Wang, B. Y. Hayden, R. Moreno-Bote, (Poster) “*Is your gaze your aim? Eye position in reward gambling [...] in encoding the value of visually cued offers.*”, Sociedad Española de neurociencia (SENC), Nov. 2021 (Lleida, ES).
- Barccsyn 2021 **D. Ferro**, A. Rifé-Mata, T. Cash-Padgett, M. Z. Wang, B. Y. Hayden, R. Moreno-Bote, (Poster) “*Is your gaze your aim? Eye position in reward gambling and the role of orbitofrontal cortex in encoding the value of visually cued offers.*”, Barcelona Computational, Cognitive, Systems Neuroscience (BARCCSYN), July 2021 (Barcelona, ES).
- INT 2020 **D. Ferro**, J. van Kempen, M. Boyd, S. Panzeri, A. Thiele, “*Effects of attention on Granger causal interactions between cortical layers and cortical areas V1 and V4*”, Institut de Neuroscience de la Timone (INT), Feb. 2020 (Marseille, FR).
- SfN 2019 **D. Ferro**, J. van Kempen, M. Boyd, S. Panzeri, A. Thiele, “*Effects of attention on Granger causal interactions between cortical layers and cortical areas V1 and V4*”, Annual Meeting of the Society for Neuroscience (SfN), 2019 (Chicago, IL, USA).
- Unitn 2019 **D. Ferro**, J. van Kempen, M. Boyd, S. Panzeri, A. Thiele, “*Effects of attention on visual processing between cortical layers and cortical areas V1 and V4.*”, PhD Doctoral student Day at the University of Trento, 2019 (Rovereto, IT).
- Unitn 2017 **D. Ferro**, J. van Kempen, M. Boyd, S. Panzeri, A. Thiele, “*Effects of attention on visual processing between cortical layers and cortical areas V1 and V4*”. Ten Years of Mind/Brain Sciences Conference at the University of Trento, 2017 (Rovereto, IT).
- SfN 2017 A. Thiele, **D. Ferro**, M. Boyd and S. Panzeri, “*Layer dependent attentional modulation of broad and narrow spiking cells in primate V1*”, Annual Meeting of the Society for Neuroscience (SfN), 2017 (Washington, DC, USA).

Participations

- Barccsyn 2024 Barcelona Cognitive, Computational and Systems Neuroscience, May 2024 (Barcelona, ES).
- Barccsyn 2023 Barcelona Cognitive, Computational and Systems Neuroscience, May 2023 (Barcelona, ES).
- HBP 2023 Anatomy and function of the prefrontal cortex across species, Human Brain Project (HBP), March 2023 (Paris, FR).
- HBP 2023 Coredem (Human Brain Project, Work Package 2), July 2022 (Paris, FR).
- Barccsyn 2022 Barccsyn Retreat: 7th retreat of Barcelona Computational Systems Neuroscience community (S. Feliu de Guixols, ES).

- NeuCod 2018 Neural Coding Conference at the University of Turin, Sept. 2018 (Turin, IT).
- Lab Fair 2018 University department Lab fair. Introduced people to the lab and outlined main research lines/goals of the group. (*CNCS - Italian Institute of Technology*), Nov. 2018 (Rovereto, IT).

Further activities

- Feb. 2022 Retreat Organizer: 7th retreat of the Barcelona Cognitive, Computational Systems Neuroscience community (program).
- March 2017 Brown-Bag Organizer. Weekly, lunch-time, informal meetings involving people from the whole research center. Talks could range from abstract ideas to paper discussion, projects progress update, presentations by visiting scientists. (*CNCS - Italian Institute of Technology*)
- April 2018
- July 2017 Server maintenance. Led the maintenance of remote computer workstations managing remote access and desktop control/casting services.
- March 2018
- Jan. 2016 Graphics and web design. Full design of web sites and graphical user interface/experience tools. Took part in programming competitions organized by local (Turin, IT area) start-ups.
- Oct. 2018