Luigi Petrucco

EMBO Postdoctoral Fellow @ Iurilli lab

Center for Neuroscience and Cognitive Systems/
Istituto Italiano di Tecnologia
Rovereto, Italy

DETAILS

birth 22/11/1992, Italy
email luigi.petrucco@iit.it
GitHub github.com/vigji
Personal website vigji.github.io

EDUCATION

2016 – 2022 **Ph.D. in Systemic Neurosciences at LMU** (München, Germany)

2011 – 2016 ***Diploma di Licenza* in Biology** at Scuola Normale Superiore (Pisa, Italy)

2014 – 2016 **M.S. in Biology Applied to Biomedicine – Neurobiology** at University of Pisa (Pisa, Italy)
110/110 *cum laude*

2011 – 2014 **B.S. in Biology** at University of Pisa (Pisa, Italy)
110/110 *cum laude*

RESEARCH EXPERIENCE

Mar 2023 – *present* EMBO Postdoctoral Fellow at **Center for Neuroscience and Cognitive Systems/IIT** (Rovereto, Italy)
Supervisor: Dr. Giuliano Iurilli
Topics: *in vivo* electrophysiology, rodents, hunting, optogenetics, computational ethology

May 2022 – Feb 2023 Postdoc at **Center for Neuroscience and Cognitive Systems/IIT** (Rovereto, Italy)
Supervisor: Dr. Giuliano Iurilli
Topics: *in vivo* electrophysiology, rodents, hunting, optogenetics, computational ethology

Sept 2017 – Apr 2022 Ph.D. research work at **Max Planck Institute of Neurobiology** / **Technische Universität München (TUM)** (München, Germany)
Supervisor: Prof. Ruben Portugues
Topics: lightsheet and electron microscopy, zebrafish, navigation, hindbrain, cerebellum

Oct 2014 – Sept 2016 MS Thesis at **NEST Laboratory, Scuola Normale Superiore** (Pisa, Italy)
Supervisor: Prof. Gian Michele Ratto
Topics: *in vivo* two-photon imaging/electrophysiology, rodents, epilepsy

Summer 2015 Internship at **Harvard University** (Cambridge, Massachusetts)
Supervisor: Prof. Takao K. Hensch
Topics: two-photon imaging, voltage imaging, slice, rodents, cortex

Summer 2013 Internship at **Max Planck Institute for Chemical Ecology** (Jena, Germany)
Supervisor: Dr. Ewald Grosse-Wilde
Topics: FISH, confocal microscopy, insects, olfaction

TEACHING EXPERIENCE

Feb 2024 – *ongoing* In charge of **Python for Open Neuroscience** (*incarico di collaborazione occasionale* with CIMeC Graduate Program in Cognitive and Brain Sciences, University of Trento; 32h course)

Apr – Jun 2023 In charge of **Python for Open Neuroscience** (*incarico di collaborazione occasionale* with CIMeC Graduate Program in Cognitive and Brain Sciences, University of Trento; 24h course)

Apr – Jun 2023	Local instructor for **Cajal Neurokit Course: Visual Reactive Programming for Neuroscience – Bonsai 2022** (satellite course hosted at ACN/CIMeC)
Apr – 2022	Teaching Assistant at Edmond/Lily Safra Center for Brain Sciences-ELSC/TUM **Microscopy and Imaging Course** (*Prof. R. Portugues,* TUM)
Mar – Jul 2021	Teaching Assistant at the course **Large Scale Modelling and Large Scale Data Analysis** (*Prof. Ruben Portugues,* TUM)

ADVANCED TRAINING

Jul 2017	**Cajal Course – Interacting with Neural Circuits** (*FENS; Lisbon, Portugal*)
Aug 2016	**Cajal Course – Computational Neuroscience** (*FENS; Lisbon, Portugal*)
Mar 2016	**Munich Brain Course** (*Ludwig-Maximilians-Universität – LMU Munchen, Germany*)

LAB/HARDWARE SKILLS

Behavior	Restrained and freely moving **behavioral assays in mice and zebrafish larvae**. Experiment control with **custom open loop and closed-loop rigs** programmed in Python, Labview, Bonsai (visual, acustic, olfactory, mechanosensory stimulation, virtual reality systems; high-performance animal pose tracking, vitals monitoring).
Electrophysiology	High density **extracellular recordings** (Neuropixel) and **single unit recordings** in behaving and anaesthetized rodents; basic experience with single unit recordings in zebrafish larvae. Introductory knowledge of *whole-cell* patch clamp in slice.
Optophysiology	Volumetric, **whole brain calcium imaging** in behaving zebrafish larvae by **lightsheet** and **two-photon microscopy**; two-photon and wide-field imaging in behaving mice. Experience with *in slice* voltage imaging.
Rigs	**3D printing** with filament and resin printers, laser cutting, soldering, basic circuits for sensors and servo/stepper/valves actuators control
Optogenetics	**Fiber-based optogenetic manipulation** of deep brain areas in behaving rodents; introductory knowledge of **holographic systems** for targeted stimulation in zebrafish.
Surgical procedures	Rodent **surgeries for electrophysiological recordings**; cranial window placing for imaging; **AdenoAssociated Viruses** (AAVs) injections
Optics	**Assemblage and maintenance of two-photon and lightsheet microscopes**: optic bench alignment procedures, galvos/scanning systems.
Electronics	**Arduino**, RasberryPi, BPod, **NI-DAQ & Labjack** for digitization and signal generation; op-amps, signal amplification/filtering.
Histology	**Vibratome/cryostate** usage; slice mounting; some experience with antibody staining and in situ hybridization; Whole brain **confocal imaging** in zebrafish larvae
Molecular biology	Basic experience with plasmid cloning; zebrafish egg plasmid injection for transient expression and transgenesis in zebrafish; genotyping in mice and zebrafish.
Animal husbandry	**Zebrafish handling** (FELASA Function A accredited course) stock breeding and maintenance, animal monitoring, mating for egg collection. **Mice handling** (*corso di formazione teorica e pratica, funzione A*) breeding schemes, water restriction protocols.

SOFTWARE SKILLS

Data analysis	**High performance data analysis** pipelines design, maintenance, testing, documenting, and deployment.

Behavioral datasets: image processing and convolutional neural networks for pose estimation, behavioral segmentation (DeepLabCut, SLEAP, KP-MoSeq).
Calcium imaging datasets: visualization of large-scale datasets, registration, ROI extraction, deconvolution; (Suite2p, CaIMAN) volumetric registration (ANTsPy, DIPY).
Electrophysiological recordings: visualization drift correction, spike sorting, data curation (Kilosort, spikeinterface, Phy).
Volumetric electron microscopy datasets: manual skeletonization and neural network-assisted segmentation (Knossos).

Data/code management

Relational databases for experiment data storage; Familiarity with **open data formats** for neuroscience (BIDS, NWB);

Machine learning

Dimensionality reduction and **clustering** methods; Linear and multilinear regression procedures for neural data; Familiar with the **principles of neural network training** algorithms. Infrastructure maintenance for **neural network training on GPU** (Tensorflow/PyTorch)

Programming Languages

Python (proficiency) MATLAB; fundamentals of **R, Julia** and **C#**; Arduino applications with C; **LabView**. Version control/Continuous integration with **GitHub**/Travis/GitHub Actions.

Operative Systems and programs

Windows, Mac, and Linux/WSL; Office package, SPSS, LaTeX, Photoshop, Gimp, Illustrator, InDesign, Inkscape, Blender

OPEN-SOURCE SOFTWARE

Core developer:

- `Stytra`: suite for closed-loop behavioural experiments. Stytra has been employed by tens of researchers for experiments on zebrafish, flies, and rodents.
- `brainglobe-atlasapi`: library to create and use anatomical atlases
- `brainglobe-space`: utilities for anatomical coordinates transformations

Contributor:

- `Brainrender`: 3D visualization of data registered onto brain atlases
- `Napari`: widely adopted imaging data visualization interface.
- `Pynapple`: Python interface for physiology and behaviour experiments.

AWARDS & FUNDING

Jun 2024 — **FENS-Kavli PhD Thesis prize** (best neuroscience thesis award 2022-2024; *FENS-Kavli Network of Excellence – FKNE, EU*)

Dec 2022 — **EMBO Postdoctoral Fellowship** (€ 110.000; *European Molecular Biology Organization – EMBO, EU*)

Sept 2021 — **Kavli Seed Grant** Stytra-to-NWB data conversion (€ 10.000; *Kavli Foundation, USA*)

Jul 2017 — **FENS travel grant**, full fee waiver for the Cajal Course Interacting with Neural Circuits 2017 (*FENS, EU*)

Aug 2016 — **FENS travel grant**, full fee waiver for the Cajal Course Computational Neuroscience 2016 (*FENS, EU*)

March 2016 — **Munich Brain Course Award** full fee waiver and travel grant for the Munich Brain Course (*LMU Munchen, Germany*)

Jul 2015 — **Armenise-Harvard Fellowship** (*Armenise-Harvard Foundation, Italy-USA*)

Jun 2013 — **RISE Scholarship** (*German Academic Exchange Service – DAAD, Germany*)

2011-2016 — **Full tuition Scholarship** (*Scuola Normale Superiore, Italy*)

TALKS

2023

Invited talk at Ernst Strüngmann Institute (ESI) for Neuroscience (*online*): *Neural dynamics and architecture of the heading direction circuit in zebrafish*

Talk at **Open tools, code and data standards for animal brain research** (*CIMeC – University of Trento, online*): *Brainglobe: computational neuroanatomy across the phylogenetic tree;* link: https://www.youtube.com/watch?v=BPhcnKgkl4U

2022

Invited talk at Max Planck Institute for Animal Behavior (*Konstanz, Germany*): *Neural dynamics and architecture of the heading direction circuit in zebrafish*

Cosyne 2022 (*Lisbon, Portugal*): *A network that integrates heading direction in the larval zebrafish brain* (Talk, top 5% of abstracts selected;
link: youtu.be/-7gNchGxI9s?t=9056)
Petrucco L.; Lavian, H.; Wu, Y. K.; Svara, F.; Štih, V.; Portugues, R.

9th European Student Conference on Behavior & Cognition (*Rovereto, Italy*) *A circuit for heading direction representations in larval zebrafish*
Petrucco L.; Lavian, H.; Wu, Y. K.; Svara, F.; Štih, V.; Portugues, R.

2021

Invited talk at Center for Neuroscience and Cognitive Systems-IIT (*Rovereto, Italy***):** A network for heading direction integration in the zebrafish brain.

2020

Neuromatch 3.0: *BrainGlobe: a Python ecosystem for computational (neuro)anatomy* (Online talk; link: youtube.com/watch?v=4tcbeLzrZ6I)
Petrucco L.; Claudi F.; Tyson, A.; Branco T.; Margrie T.; Portugues R.

INTERNATIONAL COLLABORATIONS

2023 – ONGOING

Organizer in the Nencki Open Lab network (https://nenckiopenlab.org/academy/): The Open Lab fosters grass-root initiatives for the discussion of new ideas and frameworks in neuroscience and the dissemination of knowledge on tools for neuroscience. Its activities are supported by prestigious grants from IBRO, The Company of Biologists, The Simons Foundation, and others.

2020 – ongoing

Co-founder of the BrainGlobe initiative (https://brainglobe.info) with colleagues from the Sainsbury Wellcome Center (SWC). BrainGlobe is an ecosystem of interoperable Python tools for computational neuroanatomy.

The project now a multi-national consortium of neuroscientists and developers from Europe, UK and USA (including Princeton University, the Kavli Institute for Systems Neuroscience, Tel Aviv University and the Francis Crick Institute) and has received more than € 400.000 in funding from the SWC (http://tinyurl.com/mvmkhncm) and the Chan Zuckerberg Initiative (http://tinyurl.com/4py7bpxp)

REVIEWER ACTIVITY

Reviewer for

- Journal of Open Source Scientific Software – JOSS;
- BMC Bioinformatics;
- Nature Communications (co-reviewer)

WORKSHOP ORGANIZATION

2024 — Organizer of ***Nencki Open Lab Workshop: Rethinking Naturalistic behavior*** in Terzolas, **Trento**. Independent workshop supported by Nencki Institute of Experimental Biology and IBRO; featuring speakers from the Max Planck Institute for Animal Behavior, Cornell University, Champalimaud Center for the Unknown, TUM, and University of Oslo, and received applications from students and scholars across Europe (>80% foreign applicants).

WORKSHOP PARTICIPATION

2023 — **Nencki School of Ideas in Neuroscience** (*Nencki Open Lab, Warsaw, Poland*)

Subcortical sensory circuits: visual, auditory, somatosensory (*EMBO, online*)

CogEvo 2023 (*CIMeC – University of Trento, Rovereto, Italy*)

Neuropixels Course 2023 (*UCL - online*)

MoSeq Workshop 2023 (*Harvard University - online*)

2021 — **BrainGlobe hackathon** for the development of open tools for computational neuroanatomy (*UCL Bioimaging Facility*, online)

2019 — **eLife Innovation Sprint 2019**: hackathon on open publishing practices (*eLife Foundation, Cambridge, UK*)

The Future of Neuroscience Symposium (*Max Planck Institute of Neurobiology, Martinsried, Germany*)

Python Get Together (*Max Planck Institute of Neurobiology, Martinsried, Germany*)

2017 — **Computer Vision in Animal Behaviour Studies** (*TUM, Munich, Germany*)

Mathematical Modelling in Biology (*LMU, Munich, Germany*)

2015 — **4th Champalimaud Neuroscience Symposium** (*Champalimaud Center for the Unknown, Lisbon, Portugal*)

CO-SUPERVISED STUDENTS

Nov 2021 - Apr 2022 — Ph.D. student Anja Domadenik: Integration of behaviorally-relevant visual information into a heading direction representation of larval zebrafish (*TUM, Prof. R. Portugues*)

Nov 2021 – Apr 2022 — M.S. student Federico Puppo: Sashimi: a Python library for lightsheet microscopy (*TUM, Prof. R. Portugues*)

Mar 2021 – Jul 2021 — M.S. student Hanyi Jiang: Aligning large-scale electron microscopy data (*TUM, Prof. R. Portugues*)

Apr 2018 – Sep 2018 — M.S. student Ot Prat: Luminance responses in the zebrafish cerebellum (*GSN-LMU Prof. R. Portugues*)

SCIENTIFIC SOCIETIES AFFILIATIONS

Società Italiana di Neuroscienze

OUTREACH/MENTORING

2023 — *So long, and thank for all the zebrafish*: interview with Francesca Lanzarini for the podcast *How animal's brain works*

2020 – ONGOING — Mentor for the *Lead the future community* (career mentoring program; 4 mentees so far)

2021 -2023 — INTRODUCTORY NEUROSCIENCE LECTURES FOR HIGH SCHOOL STUDENTS (IN COLLABORATION WITH CHIARA TEMPO, LICEO PERCOTO HIGH SCHOOL UDINE, ITALY)

2019 — *Neurocamp* mentor for visiting high-school students at Max Planck of Neurobiology

2018 — *A Virtual Journey in the brain of a fish.* Stand at the Max Planck Open Doors event; featuring an immersive virtual reality experience diving into real brain imaging data

Bit vs. Qbit An introduction about computing in digital and biological systems (Liceo Marinelli High School/University of Udine)

FIRST/CO-AUTHOR PUBLICATIONS

2024 — **Petrucco L.***, Wu Y.K.*, Portugues R. (2024) A glomerular organization for the interpeduncular nucleus of the teleost brain [IN PREPARATION]

Prat O.*, **Petrucco L.***, Štih V., Portugues R. (2024) Comparing the representation of a simple visual stimulus across the cerebellar network.
eNeuro 3 July 2024; DOI: doi.org/10.1523/ENEURO.0023-24.2024

2023 — **Petrucco L.***, Lavian H.*, Wu Y.K., Svara F., Štih V., Portugues R. (2023) Neural dynamics and architecture of the heading direction circuit in a vertebrate brain.
Nature Neuroscience 26, 765-773, DOI: doi.org/10.1038/s41593-023-01308-5

2020 — Claudi F.*, **Petrucco L.***, Tyson A.L.*, Branco T, Margrie T.W., Portugues R. (2020) BrainGlobe Atlas API: a common interface for neuroanatomical atlases.
Journal of Open Source Software 5 (54), 2668 DOI: doi.org/10.21105/joss.02668

2019 — Štih V.*, **Petrucco L.***, Kist A.M., & Portugues R. (2019). Stytra: an open-source, integrated system for stimulation, tracking and closed-loop behavioral experiments.
PLoS computational biology, 15(4), e1006699. DOI: doi.org/10.1371/journal.pcbi.1006699

2017 — **Petrucco L.***, Pracucci E.*, Brondi M., Ratto G.M., & Landi S. (2017) Epileptiform activity in the mouse visual cortex interferes with cortical processing in connected areas.
Scientific reports, 7(1), 1-12. DOI: doi.org/10.1038/srep40054

*authors contributed equally

OTHER PUBLICATIONS

2024 — Dehaqani A.A.*, Michelon F.*, Patella P.*, **Petrucco L.**, Piasini E., Iurilli G. (2023) A mixed mechano-olfactory code for sniff-invariant odor representations.
Cell Reports 43, issue 4, pages
(bioRXiv 2023.04.04.535405; DOI: doi.org/10.1016/j.celrep.2024.114013

2022 — Xiao Y., **Petrucco L.,** Hoodless L.J., Portugues R., Czopka T. (2022) Oligodendrocyte Precursor Cells Sculpt the Visual System by Regulating Axonal Remodeling,
Nature Neuroscience 25, pages 280–284, DOI: doi.org/10.1038/s41593-022-01023-7

2021 Claudi F., Tyson A.L., **Petrucco L.**, Margrie T.W., Portugues R., Branco T. (2021) Visualizing anatomically registered data with brainrender.
eLife, 10, e65751: DOI: doi.org/10.7554/eLife.65751

Markov D.A., **Petrucco L.**, Kist A.M., & Portugues R. (2020) A cerebellar internal model calibrates a feedback controller involved in sensorimotor control.
Nature Communications 12 (6694) DOI: doi.org/10.1038/s41467-021-26988-0

2019 Landi S., **Petrucco L.**, Sicca F., & Ratto G.M. (2019). Transient cognitive impairment in epilepsy.
Frontiers in molecular neuroscience, 11, 458; DOI: doi.org/10.3389/fnmol.2018.004588

POSTERS

2024 **5th Interdisciplinary Navigation Symposium – iNav 2024**. Integration of visual information in the zebrafish head direction system.
Lavian H., **Petrucco L.**, Štih V., Portugues R.

5th Interdisciplinary Navigation Symposium – iNav 2024. Integration of behaviorally-relevant visual information into the heading direction representation of larval zebrafish.
Domadenik A., **Petrucco L.**, Lavian H., Wu Y.K., Tanaka R., Portugues R.

2023 **Society for Neuroscience – SfN Meeting 2023.** A mixed mechano-olfactory code for sniff-invariant odor representations.
Dehaqani A.A., Michelon F., Patella P., **Petrucco L.**, Piasini E., Iurilli G.

Society for Neuroscience – SfN Meeting 2023: The BrainGlobe initiative: an open-source neuroanatomy platform for the 21st century.
Tyson A.*, Claudi F.*, **Petrucco L.***; Branco T., Margrie T., Portugues R.

2022 **Federation of European Neuroscience Societies (FENS) Forum 2022.**
BrainGlobe: a Python ecosystem for computational (neuro)anatomy
Petrucco L., Claudi F., Tyson A., Branco T., Margrie T., Portugues R.

Janelia Conferences: Structure and Function of the Insect Central Complex
Integration of visual information into a heading direction representation of larval zebrafish;
Domadenik A., **Petrucco L.**, Lavian H., Wu Y.K., Svara F., Štih V., Portugues R.

2021 **European Glial Meeting 2021.** Oligodendrocyte Precursor Cells Sculpt the Visual System by Regulating Axon Remodeling
Xiao Y., Hoodless L.J., **Petrucco L.,** Portugues R., Czopka T.

2020 **Federation of European Neuroscience Societies (FENS) Forum 2020.** Dissecting sensory representations of a simple visual stimulus in the input streams of the cerebellar circuit
Petrucco L., Prat O., Štih V., Portugues R.

2019 **WireUp Symposium of the Max Plank Society.** Anatomical and physiological characterization of eurydendroid cells.
Petrucco L., Palieri V., Knogler L., Bazhanova O., Kist A.M., Portugues R.

Symposium of the Società Italiana di Neuroscienze. Anatomical and physiological characterization of eurydendroid cells.
Petrucco L., Palieri V., Knogler L., Bazhanova O., Kist A.M., Portugues R.

2018 **Federation of European Neuroscience Societies (FENS) Forum 2018:** Stytra: an open source, integrated system for stimulation, tracking and virtual reality experiments.
Štih V., **Petrucco L.,** and Portugues R.

2016 **SleepSpindles 2016:** Focal interictal activity in the mouse visual cortex interferes with slow-wave oscillations and visual processing in the contralateral hemisphere
Petrucco L., Pracucci E., Brondi M., Ratto G.M., Landi S.

2014 **SfN 2014:** Acute alterations of the excitation/inhibition equilibrium interfere with normal visual processing in the adult mouse.
Brondi M., Landi S., **Petrucco L.**, Pracucci E., Sulis Sato S., Ratto G.M.

OPEN-SOURCE DATASETS

[**Main data curator**] Petrucco L.*, Lavian H.*, Wu Y.K., Svara F., Štih V., Portugues R. (2023) Neural dynamics and architecture of the heading direction circuit in a vertebrate brain. (DOI: https://zenodo.org/doi/10.5281/zenodo.6847130)
Dataset featuring calcium imaging data of the heading direction network in the larval zebrafish anterior hindbrain, and EM skeleton reconstructions of r1π neurons.

[**Main data curator**] Prat O.*, Petrucco L.*, Štih V., Portugues R. (2022) Comparing the representation of a simple visual stimulus across the cerebellar network (DOI: https://zenodo.org/doi/10.5281/zenodo.7071734)
Dataset featuring calcium imaging data in subpopulations of the cerebellum (granule cells, purkinje cells, inferior olive cells) during presentation of simple luminance stimuli.

[**Main data curator**] Xiao Y., Petrucco L., Hoodless L.J., Portugues R., Czopka T. (2022) Oligodendrocyte Precursor Cells Sculpt the Visual System by Regulating Axonal Remodeling (DOI: https://zenodo.org/doi/10.5281/zenodo.5894603)
Dataset featuring receptive field mapping in the optic tectum of zebrafish larve with and without chemogenetic ablation of Oligodendrocyte Precursor Cells.

Markov D.A., Petrucco L., Kist A.M., & Portugues R. (2020) The cerebellum recalibrates a feedback controller involved in motor control
(DOI: https://zenodo.org/doi/10.5281/zenodo.5052784)
Dataset featuring 70 whole-brain calcium imaging sessions in zebrafish larvae performing an optomotor task.

LANGUAGE SKILLS

Italian (native); English (proficient); German (beginner)