



Mattia Tambaro

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ABOUT ME

Computer scientist, with a PhD in Neuroscience. I have experience in FPGA implementations and microcontrollers programming, and in the development of the controlling software and GUI running on computer. I developed custom processing analysis of neural time series using Matlab, and I gained experience in the characterization of biological interfaces through electronic measurements. Particularly, my expertise focus on HW/SW development of acquisition and processing pipelines for electrical measurements of electrophysiological signal, as well as the analysis of the acquired data, commonly using Matlab and/or Python.

I actively worked in 2 European projects, collaborating with teams across different countries, besides having carried out collaborations with other Italian departments and universities. I could also tutor younger students, as master and internship. These experiences taught me to deal with the organization of my work, but also with the coordination of the join effort of multiple people.

By working as a PhD student, I learned to be autonomous and proactive in completing tasks, finally delivering a clear representation of the methodology and results.

EDUCATION AND TRAINING

PhD in Neuroscience

Padova Neuroscience Center - University of Padova [09/2019 – 12/2022]

Address: Padova (Italy)

Final grade: Ottimo

Thesis: A brain-silicon closed-loop hybrid system with synapse-inspired neuroelectronic links

Neuroscience PhD elective courses: Preliminary course on use of R, Principles of neuronal biophysics, physiology, and processing, Basic concepts of statistics, europsychology (attention and visuo-spatial functions), Laboratory of tractography and fibers, Comparative anatomy and physiology, Programming in Python, Neuropsychology of executive functions, Methods in Psychophysiology, Presentation skills and public outreach, Graph theory and null models, The scientific method: practical issues, Controllability, Light-based methods for brain circuit analysis, Data reduction (PCA, ICA) and/or permutation, Basic introduction to Bayesian reasoning.

Master in Computer Science

University of Milano-Bicocca [07/2017 – 03/2019]

Address: Milano (Italy)

Final grade: 110L

Thesis: FPGA implementation for real time detection of neuronal spike using Principal Component Analysis

Complex systems: models and simulation, Data and software architectures, Informatics for industrial applications, Machine learning, Methods of scientific computing, Models and computation, Probabilistic models for decision making, Computer security, Design lab, Machine perception and robotics, Telecommunication systems and services

Erasmus+

University of Tromsø, during the master in Computer science [02/2018 – 07/2018]

Address: Tromsø (Norway)

Distributed system technologies and applications, Digital image processing.

Computer science

University of Milano-Bicocca [09/2012 – 11/2016]

Address: Milano (Italy)

Thesis: EEG data analysis in visual search tasks

Algorithms and data structures, Basic calculus, Computer architecture, Fundamentals of computer science, Mathematics complements, Programming 1, Programming 2, Data bases, Distributed systems, Languages and computability, Operating systems and networks, Physics, Probability and statistics for computer science, Programming languages, Software specification and design, Design and analysis of algorithms, Embedded systems, Operations research and resource planning, Processing and coding of multimedia data, Robotics and automation

WORK EXPERIENCE

Post-doc researcher

NeuroChipLab - University of Padova [01/2023 – Current]

City: Padova

Country: Italy

Supervisor: Stefano Vassanelli

Role: contributor on SYNCH and Neureka European projects.

Task: systems integration for closed-loop experiments purpose; instrumental measurements; data acquisition, processing, and analysis; inter-unit results reporting and perspective discussion, students tutoring.

PhD student

NeuroChipLab - University of Padova [10/2019 – 12/2022]

City: Padova

Country: Italy

Supervisor: Stefano Vassanelli

Role: contributor on SYNCH European projects, primary topic of the PhD, and on Neureka European project.

Task: electrophysiology instrument HW/SW development; custom analysis of neural data development (Matlab, Python); characterization of the electrical stimulation of brain tissue and neurons; instruments and equipments management and measurements; inter-unit reporting of results and perspective discussion; experimental protocols planning, students tutoring.

Internship

Microelectronic group - University of Milano-Bicocca [03/2019 – 08/2019]

City: Milano

Country: Italy

Supervisor: Marcello De Matteis

Role: research activity support; master thesis divulgation, students tutoring.

PROJECTS

Synaptically connected brain-silicon neural Closed-loop Hybrid system (SYNCH)

[10/2019 – Current]

HORIZON2020 - ID: 824162

The project wants to create a hybrid system where a neural network in the brain of a living animal and a spiking neural network of in-silico neurons on a chip are interconnected by memristor-based neuromorphic synapses, enabling co-evolution of connectivity and co-processing of information of the two networks.

Role:

development of the real-time bidirectional brain-computer interface on the FPGA of an electrophysiology recording system for the purpose of closed loop experiments, to detect the ongoing intracortical neuronal activity and manage the stimulation; integration of the interface with the other components of the project; characterization of the feedbacks available to the SNN via intracortical microstimulation in the somatosensory cortex of rats.

Our group was the leader unit of the project. I actively took part in the plenary meetings with the partners of the consortium, presenting the results of our unit and proposing new approaches to the problems faced by the groups.

I managed the organization of multiple physical meetings involving the partners from different European universities for the integration of the components of the system, where I gave active contribution thanks to my role in developing the interface.

NEUREKA - A smart, hybrid neural-silico-computo device for drug discovery

[12/2019 – Current]

HORIZON2020 - ID: 863245

An innovative hybrid technology, whereby 3D electrodes with nanowire and sophisticated computational models of neuronal circuits are combined to readout and manipulate activity/connectivity in cultured neuronal networks of Alzheimer's disease, accessing dendritic computation.

Role: nanowire array chip impedance measurements and spectrum characterization;
synchronous patch-clamp and electrodes recording and stimulation measurements;
data acquisition, processing, and analysis.

I actively took part in the plenary meetings with the partners of the consortium, presenting the results of our unit and proposing new approaches to the problems faced by the groups.

Proton Sound Detector (ProSD)

[2019 – 2021]

CSN5 INFN Project

Design and development of low-noise detectors and electronics for ionoacoustic localization of the Bragg Peak of a proton beam interacting with a water absorber.

Role: development of FPGA-computer interface for the data acquisition during measurements of the proton beam.

Autonomous In-vivo Brain-Machine-Interface with Ultrasound-based Power Harvester and Communication-Link (Brain28nm)

[2019 – 2021]

Design and development of an In-vivo Brain-Machine-Interface in 28nm-CMOS technology with ultrasound-based power-harvester and communication-link.

Role: investigation and testing of low-power and low-resources algorithms for spike detection.

paMELA - Photoacoustic Melanoma Detector

[04/2021 – Current]

Crowdfunded project, winner (1st/24) of Bicocca University of Crowdfunding (BiUniCrowd), raising 9245 € during the campaign (April-May 2021) and a total of 23k € from subsequent funding.

Design and development of a low-cost photoacoustic probe for early-stage melanoma diagnosis.

Role: simulations of acoustic propagation and testing of source reconstruction algorithms; data acquisition/ processing for source reconstruction; FPGA-computer interface development for laser driver and acoustic signal acquisition and processing.

TEACHING ACTIVITY

Seminar

[04/2019]

Seminar entitled "FPGA implementation for real-time detection of neuronal spikes" at the department of Informatics, Systems and Communication within the course of Informatics for industrial applications Informatics for industrial applications, Master's degree in Informatics.

Tutoring

Tutoring of computer science master students working on the thesis:

"Preliminary study on the use of neural networks for the real-time detection of LFP evoked by sensory stimuli";

"Latent variable models and sequence detection for neural population dynamics";

"Pattern recognition in intracortical recordings of sensory stimulations with Machine Learning techniques";

"FPGA-Based Imaging of Energy Volumetric Deposition by Optoacoustic Effect".

Tutoring of a biotechnology internship student:

supervision of a Matlab project for the processing and analysis of time series: "Development of analysis pipelines in MATLAB for electrophysiological signals in vitro and in vivo".

Tutoring of a psychology internship student:

introduction to Matlab and Python for the processing and analysis of time series.

TRAINING

The Computational Neuroscience, Neurotechnology and Neuro-inspired AI

[24/10/2022 – 28/10/2022]

Ulster University, Londonderry, Northern Ireland

Neural circuit complexity: Neuroscience, Models and Robotics (BrainCosmos)

[30/08/2021 – 03/09/2021]

Lake Como School of Advanced Studies, Como, Italy

Smart city looks like

[16/07/2018 – 25/07/2018]

University of Milano-Bicocca and Eurasian National University, Astana, Kazakhstan

CONFERENCES AND SEMINARS

IEEE Biomedical circuits and systems conference (BioCAS)

[Taipei, Taiwan, 13/10/2022 – 15/10/2022]

Poster presentation of the work entitled "A firing rate independent threshold estimation for neuronal spike detection methods".

International Conference on SMACD and 16th Conference on PRIME

[Erfurt, Germany, 15/07/2021 – 18/07/2021]

Speaker at the conference, presenting the paper entitled "A scalable spike detection method for implantable high-density multielectrode array".

26th IEEE International Conference on Electronics Circuits and Systems (ICECS)

[Genova, Italy, 27/11/2019 – 29/11/2019]

Speaker at the conference, presenting the paper entitled “10 MSample/Sec Digital Neural Spike Detection for a 1024 Pixels Multi Transistor Array Sensor”.

29th IEEE International Conference on Electronics Circuits and Systems (ICECS)

[Glasgow, United Kingdom, 24/10/2022 – 26/10/2022]

Reviewer for the conference.

15th International Conference on Brain Informatics

[Padova, Italy, 15/07/2022 – 17/07/2022]

Local Organization Chairs for the conference.

PUBLICATIONS

FPGA Design Integration of a 32-Microelectrodes Low-Latency Spike Detector in a Commercial System for Intracortical Recordings

[2021]

Digital, 1(1), 34-53

M. Tambaro, M. Bisio, M. Maschietto, A. Leparulo, S. Vassanelli.

Evaluation of In Vivo Spike Detection Algorithms for Implantable MTA Brain—Silicon Interfaces

[2020]

Journal of Low Power Electronics and Applications (JLPEA), 10(3), 26

M. Tambaro, E. A. Vallicelli, G. Saggese, A. G. M. Strollo, A. Baschiroto, S. Vassanelli.

Comparison of Sneo-Based Neural Spike Detection Algorithms for Implantable Multi-Transistor Array Biosensors

[2021]

Electronics, 10(4), 410

G. Saggese, M. Tambaro, E. A. Vallicelli, A. G. M. Strollo, S. Vassanelli, A. Baschiroto, M. De Matteis.

A firing rate independent threshold estimation for neuronal spike detection methods

[2022]

IEEE Biomedical Circuits and Systems Conference (BioCAS), pp. 583-586

M. Tambaro, S. Vassanelli.

A scalable spike detection method for implantable high-density multielectrode array

International Conference on SMACD and 16th Conference on PRIME, pp. 368-371

M. Tambaro, E. A. Vallicelli, G. Saggese, A. La Gala, M. Maschietto, A. Leparulo, A. G. M. Strollo, M. De Matteis, A. Baschiroto, S. Vassanelli.

A 10 MSample/Sec Digital Neural Spike Detection for a 1024 Pixels Multi Transistor Array Sensor

[2019]

26th IEEE International Conference on Electronics, Circuits and Systems (ICECS), pp. 711-714

M. Tambaro, E. A. Vallicelli, D. Tomasella, A. Baschiroto, S. Vassanelli, M. Maschietto, M. De Matteis.

Real-Time Neural (RT-Neu) Spikes Imaging by a 9375 sample/(sec pixel) 32×32 pixels Electrolyte-Oxide-Semiconductor Biosensor

[2019]

15th Conference on Ph.D Research in Microelectronics and Electronics (PRIME), pp. 233-236

M. Tambaro, E. A. Vallicelli, D. Tomasella, A. Baschiroto, S. Vassanelli, M. Maschietto, M. De Matteis.

56-MHz-Bandwidth 2.4-3.5 μ V/Pascal-Sensitivity- Range Polyvinylidene Fluoride Ultrasound Sensor Array for Biomedical Thermoacoustic Imaging

[2023]

18th Conference on PhD Research in Microelectronics and Electronics (PRIME)

Accepted, in press; M. H. Baig, E. A. Vallicelli, G. Chirico, M. Tambaro, L. Stevenazzi, M. De Matteis.

paMELA-Photoacoustic Melanoma Detector Design for Real-Time Imaging of Melanin with 18 db SNR and 10 μ m Precision

[2022]

BIODEVICES, pp. 102-108

E. A. Vallicelli, G. Chirico, M. O. Cosmi, L. Stevenazzi, M. Tambaro.

Hodgkin-Huxley Verilog-A Electrical Neuron Membrane Model

[2022]

29th IEEE International Conference on Electronics, Circuits and Systems (ICECS), pp. 1-4

Andrea La Gala, Lorenzo Stevenazzi, Elia Arturo Vallicelli, Mattia Tambaro, Stefano Vassanelli, Andrea Baschiroto, Marcello De Matteis.

140 Frames-per-Second Ionoacoustic Imaging Detector for Real-Time Particle Therapy Monitoring

[2022]

29th IEEE International Conference on Electronics, Circuits and Systems (ICECS), pp. 1-4

E. A. Vallicelli, M. O. Cosmi, M. Tambaro, A. Baschiroto and M. De Matteis.

A 0.3nV/ $\sqrt{\text{Hz}}$ Input-Referred-Noise Analog Front-End for Weakly-Interacting-Massive-Particles (WIMPs) Acoustic Sensing in Bubbles-Chamber Detectors

[2019]

15th Conference on Ph.D Research in Microelectronics and Electronics (PRIME), pp. 197-200

E. A. Vallicelli, L. Gelmi; R. Bertoni, W. Fulgione, M. Tambaro, A. Baschiroto, M. De Matteis.

HONOURS AND AWARDS

Bronze leaf award

15th Conference on Ph.D Research in Microelectronics and Electronics (PRIME) [18/07/2019]

Best 30% paper, with the work entitled "Real-Time Neural (RT-Neu) Spikes Imaging by a 9375 sample/(sec pixel) 32 $\times$ 32 pixels Electrolyte-Oxide-Semiconductor Biosensor".

LANGUAGE SKILLS

Mother tongue(s): **Italiano**

Other language(s):

English

LISTENING C1 READING C2 WRITING C1

SPOKEN PRODUCTION C1 SPOKEN INTERACTION C1

EXPERTISE

Programming languages

Matlab, Python, Java, C#, C/C++, ...

VHDL, Verilog.

Technical skills

FPGA design and synthesis suites (Xilinx ISE, Vivado), software development, digital signal processing, data acquisition and measurements, models and simulation of complex systems, statistic and probabilistic models, machine learning.

Personal skills

Autonomy: I find information and apply it independently.

Horizontality: I can range between different disciplines.

Proactivity: starting from a job I can expand it independently and find new outlets.

Activity planning: clear idea of the path necessary to reach an objective and fragmentation of the task for me and others.

Adaptability: I can collaborate with people regardless of their nature, I can also adapt to the context.

Information management: good graphical representation of information.

Problem solving: I try to find and apply "simple" solutions to complex problems. I always find a way get the job done.

NETWORKS AND MEMBERSHIPS

National Institute of Nuclear Physics (INFN)

[section of Milano-Bicocca, 10/2019 – 12/2022]

Autorizzo il trattamento dei miei dati personali presenti nel CV ai sensi dell'art. 13 d. lgs. 30 giugno 2003 n. 196 - "Codice in materia di protezione dei dati personali" e dell'art. 13 GDPR 679/16 - "Regolamento europeo sulla protezione dei dati personali".

27/04/2023



Mattia Tambaro