Federico Corradi, Ph.D.

Research & Development Scientist · Neuromorphic Engineering Expert

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Research Experience

Neuromorphic Researcher

Eindhoven, The Netherlands

IMEC R&D, NANO ELECTRONICS AND DIGITAL TECHNOLOGIES

March 2018 - now

I took part in the development of the next generation neuromorphic solutions. My focus is on developing an innovative application prototype using neural network algorithms and combining the achievements from IMEC with state-of-art components. Apart from designing embedded prototypes, I conduct research in new neural network architectures, both in hardware and software. I collect the requirements from various stakeholders and build software solution. In collaboration with IC designers, I propose new neuromorphic IC architectures. Together with other researchers at IMEC, I demonstrate these new designs and concepts in compelling demonstrators.

- Feed the neuromorphic IC designs with innovative implementations and new algorithms based on real applications.
- Develop embedded hard- and software prototypes that uses neural algorithms and or neuromorphic IC's.
- Make system trade-offs for minimal power consumption at best performance and low cost, while keeping an eye on maintainability and re-usability.
- Test, characterize and evaluate (parts of) the prototypes.
- Demonstrate the prototypes and solutions to our partners and prospects.
- Publish your results in high level journals and conferences.
- Actively contribute to the evolution of IMEC neuromorphic roadmap.

Research & Development Scientist

Zürich, Switzerland

INILABS AG

Aug. 2015 - Feb. 2018

- Inilabs develops and sells neuromorphic technologies.
- Characterization of a variety of Dynamic Vision Sensors, DAVIS and DVS.
- Characterization and development of the Dynamic Neuromorphic Asynchronous Processor, Dynap-se product.
- Involved in the Neuromorphic Processor Project (NPP) that is sponsored by Samsung. One of the main goals is to develop a digital deep neural network accelerator. Specifically, I have been working on developing Convolutional Neural Networks tailored toward easy implementation in the neural accelerator. These CNN exploit the sparse output data from the silicon retina (DVS).

PostDoc Researcher, Neuromorphic Cognitive Systems Group

Zürich, Switzerland

UNIVERSITY OF ZÜRICH

Jun. 2016 - Jan. 2017

- Working towards a new generation of brain-inspired computing platforms, i.e. neuromorphic processors. Development of Neural Network algorithms for embedded systems. Development of neuromorphic hardware. Development and implementation of deep neural networks algorithms in neuromorphic hardware. Exploring deep neural networks algorithms for visual pattern identification and classification. Development of neural network architectures tailored to neuromorphic hardware (processors, silicon retinas, and silicon cochleas).

Undergraduate Researcher, Neuromorphic Cognitive Systems Group

Zürich, Switzerland

UNIVERSITY OF ZÜRICH

Mar. 2011 - Jul. 2015

- Worked for the EU FP7 ERC project Neurop 257219 project. One of the main goal was to build event-based VLSI models of cortical circuits for brain-inspired computation.
- Developed a variety of mixed-signal analog/digital VLSI neuromorphic devices (Spikebetter, ROLLS, Ziggi) for emulating basic processes and functions of neural spiking systems.
- Realized a neuromorphic system capable of recording from neural tissue. This system is conceived as event-based Brain-Machine Interface that exploits asynchronous logic to sense and transmit information collected from neural tissue

Web Developer & System Administration

Flyer Communication

Rome, Italy

SYSTEM ADMINISTRATOR

2009 - now

Linux System administrator for a web-based company.

University of Zürich and ETH Zürich

Zürich, Switzerland

PH.D. STUDENT

2011 - 2015

Ph.D. in Neuromorphic Engineering, Neuroscience.

Immobiliare.it, Xoolab Development

Rome, Italy

WEBSITE DEVELOPER

2008/2009

Web developer in Php, Mysql, Ajax.

Education

University of Zürich and ETH Zürich
Zürich, Switzerland

Ph.D. in Neuroscience and Natural Sciences
2011 - 2015

My Ph.D. has focused at the interface between neuroscience and neuromorphic engineering, it was carried under the supervision of prof. Giacomo Indiveri. I've been investigating basic research questions that are related to the way neural circuits carry out computation and at the same time in developing a new generation of computing technologies based on neuromorphic circuits on CMOS VLSI technology. The title of my Ph.D. dissertation is "Distributed Information Processing in Neural-Inspired Microelectronic Circuits". In addition, I have successfully completed the international Ph.D. program in Neuroscience offered by the UZH and ETH.

Università La Sapienza
Rome, Italy

M.Sc. in Physics
2007 - 2010

MSc Thesis at the Italian Institute of Health (ISS) under the supervision of Prof. P. del Giudice and Prof. L. Zanello. I've been working in the computational neuroscience field researching on neuromorphic hardware. The title of my MSc thesis is "Attractor Dynamics in a Network of Spiking Neurons on VLSI Neuromorphic Chips"

Universiteit Leiden
Leiden, The Netherlands

Intern in Physics Laboratory
2005 - 2006

Worked in the MiniGRAIL team that is part of the Quantum Physics and Applications at Ultra Low Temperatures in the Lion Laboratory under the supervision of Prof. Giorgio Frossati. I participated, as exchange student during the one year Erasmus program, in testing and developing electronic instruments at low temperature for the gravitational radiational antenna. Provided research for the BSc Thesis that has been presented in Parma University.

Università degli studi di Parma
Parma, Italy

B.Sc. in Physics
2003 - 2007

Title of my BSc thesis "Study of High Quality Factor Capacitive Transducers, for Gravitational Antennas".

Teaching Experience

UZH Teaching Assistant
Zürich, Switzerland

Universität Zürich
Fall 2012

- Neuromorphic Engineering I

UZH Teaching Assistant
Zürich, Switzerland

Universität Zürich
Spring 2012

- Neuromorphic Engineering II

ETH Teaching Assistant
Zürich, Switzerland

Eidgenössische Technische Hochschule Zürich
Fall 2011

- Laboratory Electronics: Analog Circuit Design

ETH Teaching Assistant
Zürich, Switzerland

Eidgenössische Technische Hochschule Zürich
Spring 2011

- Physics Laboratory

Unix Instructor
Rome, Italy

Performa s.r.l
2009/2010

- Unix System Administrator

Extracurricular Activity

Peer Reviewer IEEE Transactions on Circuits and Systems
Online

Institute of Electrical and Electronics Engineers, IEEE
Sep. 2015 - PRESENT

- Reviewed multiple papers on circuits and systems.

Peer Reviewer IEEE Transaction Neural Networks and Learning Systems *Online*

Institute of Electrical and Electronics Engineers, IEEE *Sep. 2012 - PRESENT*

- Reviewed multiple papers on neuromorphic engineering and learning systems.

Peer Reviewer Frontiers in Neuromorphic Engineering *Online*

Fronters in Neuroscience *Sep. 2015 - PRESENT*

- Reviewed multiple papers on neuromorphic engineering and learning systems.

IEEE Computational Intelligence Society *Online*

Member *Sep. 2014 - PRESENT*

- Gained expertise computational intelligence and learning systems.
- Participated on several IEEE conferences and won an award.

Live video performers, visual artists and vj meeting *Lecture @ Mediamatic , Amsterdam*

Invited Artist *Workshop @ LPM, Amsterdam*

- Actively participated in the annual LivePerformesMeeting as a teacher in the workshop that is focusing on ”Bio algorithms for generative visuals”
- Tools: Mathematics, Dynamical Systems, C/C++, OpenFrameworks

Honors & Awards

International

2014	**Honorary Mention**, For the manuscript entitled ”Mapping Arbitrary Mathematical Functions and Dynamical Systems to Neuromorphic VLSI Circuits for Spike-based Neural Computation”, by the Neural Systems and Applications Circuits and Systems Technical Committee.	*ISCAS, Melbourne NSA Track*
2010	**MSc ”summa cum laude”**, Top physics student with evaluation of the MSC 110/110 with outstanding honor.	*University of Rome, La Sapienza, Italy*

Certification

Laser Safety Officer for technical applications *Zürich*

UVEX Academy *Feb. 2016*

- The title fulfills the requirements of the German D6UV rule 11 (hitherto BGV B2) ’Accident prevention regulation for laser beam’.

Peer-reviewed journal papers

A Sensitive Dynamic and Active Pixel Vision Sensor for Color or Neural Imaging Applications *Biomedical Circuits and Systems, IEEE Transactions on*

D.P. Moeys, F. Corradi, Chenghan Li, S. Bamford, L. Longinotti, F. F. Voigt, S. Berry, G. Taverni, F. Helmchen, T. Delbruck *2017*

doi:10.1109/TBCAS.2017.2759783

NullHop: A Flexible Convolutional Neural Network Accelerator Based on Sparse Representations of Feature Maps *submitted*

A. Aimar, H. Mostafa, E. Calabrese, A. Rios-Navarro, R. Tapiador-Morales, I. Lungu, M. B Milde, F. Corradi, A. Linares-Barranco, SC Liu, T. Delbruck *2017*

arXiv

A Neuromorphic Event-Based Neural Recording System for Smart Brain-Machine-Interfaces *Biomedical Circuits and Systems, IEEE Transactions on, Vol. 99*

F. Corradi, and G. Indiveri *2015*

doi:10.1109/TBCAS.2015.2479256

Real time unsupervised learning of visual stimuli in neuromorphic VLSI systems *Nature Scientific Reports, Vol. 5*

M. Giulioni, F. Corradi, V. Dante, and P. del Giudice *2015*

doi:10.1038/srep14730

A Re-configurable On-line Learning Spiking Neuromorphic Processor comprising 256 neurons and 128K synapses

Frontiers in Neuroscience, Vol. 9

N. Qiao, H. Mostafa, F. Corradi, M. Osswald, F. Stefanini, D. Sumislawska, and G. Indiveri

2015

doi:10.3389/fnins.2015.00141

Towards a Neuromorphic Vestibular System

Biomedical Circuits and Systems, IEEE Transactions on, Vol. 8

F. Corradi, D. Zambrano, M. Raglianti, G. Passetti, C. Laschi, and G. Indiveri

2014

doi:10.1109/TBCAS.2014.2358493

Peer-reviewed conference papers

Steering a Predator Robot using a Mixed Frame/Event-Driven Convolutional Neural Network

IEEE Event-Based Control, Communication and Signal Processing

P.M. Diederik, F. Corradi, E. Kerr, P. Vance, G. Das, D. Neil, D. Kerr, Tobi Delbrück

2016, Krakow, POL

Decision Making and Perceptual Bistability in Spike-Based Neuromorphic VLSI Systems

IEEE International Symposium on Circuits and Systems

F. Corradi, H. You, M. Giulioni, G. Indiveri

2015, Lisbon, PT

doi:10.1109/ISCAS.2015.7169245

Neuromorphic Architectures for Spiking Deep Neural Networks

IEEE International Electron Devices Meeting

G. Indiveri, F. Corradi, and N. Qiao

2015, Washington, DC, USA

doi:10.1109/IEDM.2015.7409623

Toward Neuromorphic Intelligent Brain-machine Interfaces: an Event-based Neural Recording and Processing System

IEEE Biomedical Circuits and Systems Conference

F. Corradi, D. Bontrager, and G. Indiveri

2014, Lausanne, CH

doi:10.1109/BioCAS.2014.6981793

Mapping Arbitrary Mathematical Functions and Dynamical Systems to Neuromorphic VLSI Circuits for Spike-Based Neural Computation

IEEE International Symposium on Circuits and Systems

F. Corradi, C. Eliasmith, and G. Indiveri

2014, Melbourne, VIC, AU

doi:10.1109/ISCAS.2014.6865117

A spiking implementation of the lamprey's Central Pattern Generator in neuromorphic VLSI

IEEE Biomedical Circuits and Systems Conference

E. Donati, F. Corradi, C. Stefanini, G. Indiveri

2014, Lausanne, CH

doi:10.1109/BioCAS.2014.6981775

A Hybrid Analog/Digital Spike-Timing Dependent Plasticity Learning Circuit for Neuromorphic VLSI Multi-Neuron Architectures

IEEE International Symposium on Circuits and Systems

H. Mostafa, F. Corradi, F. Stefanini, and G. Indiveri

2014, Melbourne, VIC, AU

doi:10.1109/ISCAS.2014.6865270

Automated synthesis of asynchronous event-based interfaces for neuromorphic systems

IEEE European Conference on Circuit Theory and Design

H. Mostafa, F. Corradi, M. Osswald, and G. Indiveri

2013, Dresden, DE

doi:10.1109/ECCTD.2013.6662213

Implementation of a Neuromorphic Vestibular Sensor with Analog VLSI Neurons

IEEE Biomedical Circuits and Systems Conference

G. Passetti, F. Corradi, M. Raglianti, D. Zambrano, C. Laschi, and G. Indiveri

2013, Rotterdam, NL

doi:10.1109/BioCAS.2013.6679667

Demonstrations at international conferences

Convolutional Neural Network Driven by Dynamic Vision Sensor Playing RoShamBo

IEEE Symposium on Circuits and Systems

I.-A. Lungu, F. Corradi, T. Delbruck

2017, Baltimore, MD, USA

Learning to recognize visual stimuli in neuromorphic VLSI

F. Corradi, M. Giulioni

doi:10.1109/BioCAS.2012.6418494

IEEE Biomedical Circuits and Systems Conference

2012, Hsinchu, TW

Skills

VLSI design of mixed signal analog/digital circuits	Virtuoso ADE, AMS, Layout Suite Cadence, Spice
Printed circuit board design	Altium, Eagle
Software design	C/C++, Python, OpenFrameworks
Neural network simulation of deep and/or spiking networks	Caffe Deep Learning Framework, Brian, Matlab
Dynamical System Analysis	Xppaut, Mathematica
Linux system administration of web-servers and always-on systems	Linux, Unix, Mysql, Apache2, Bash
Web design	Php, Nodejs, Mongodb, Ajax, Javascript, Css
Lanugages	Italian (mother tongue), English (fluent)