Davide Brunelli

Curriculum vitae

PERSONAL INFORMATION
Brunelli Davide

Education
- Ph.D. in *Electrical Eng., Telecommunications and Computer Science,* University of Bologna, Italy, 2007.
- M.S. in *Electrical Engineering* (summa cum laude), University of Bologna, Italy, 2002.

Present positions
2018-Today *Associate Professor* of Electronics and Embedded Systems, Department of Industrial Engineering (DII), University of Trento.

Past positions
2013-2018 *Assistant Professor* of Electronics and Embedded Systems, Department of Industrial Engineering (DII), University of Trento.
2010-2013 *Assistant Professor* of Electronics, Department of Electrical Engineering and Computer Science (DISI), University of Trento.
2007-2010 *Research fellow,* Department of Electronic, Computer Science and Systems (DEIS), University of Bologna.
2005, 2007 *Visiting researcher*, ETH Zurich, Switzerland

Professional experience
- *Consulting Professor at STMicroelectronics in 2016.*
- *Consulting Professor at the Faculty of Electrical Engineering (FER), University of Zagreb, (Croatia).*
- *Consulting Professor at the University of Bologna, (Italy) since 2010.*
- *Consulting Professor at TIM Italia (former Telecom Italia) in 2008, 2013-2015.*

Supervision of Graduate Students and Postdoctoral Fellows
2006-Today 12 Postdocs, 8 PhD students, more than 45 Master Thesis students on Energy Harvesting. Microsystem control and smart sensing, on wake-up radio systems, and bio-electric-systems.

Teaching Activities
2010-present. Teaching of *Embedded systems*, University of Trento, Italy
2010-2013. Teaching of *Hardware software co-design*, University of Trento, Italy
2010-2011. Teaching of *Digital Architectures for Signal processing*, University of Trento, Italy
2013. Teaching at the School on Body Area Network – "Energy Harvesting techniques", EPFL, CH

Institutional Responsibilities
2010-2014 Graduate Students Advisor, University of Trento, Italy
2013-2014 Ph.D. Students Advisor, University of Trento, Italy
2010-2014. Member of the International PhD school on ICT, University of Trento, Italy
2010-2014. Member of the International PhD school on Mechatronics, University of Trento, Italy

Commissions of Trust
2014, 2019 *Independent Expert Evaluator* for the European H2020 calls
2015-2018 *Independent Expert Evaluator* for Kazakhstan National Projects "EXPO 2017's Asthana"
2015 *Independent Expert Evaluator* for The Croatian Science Foundation (HRZZ), peer review for Croatian National Projects on embedded electronic systems
2015 *Independent Expert Evaluator* for Czech Science Foundation, peer review for Czech National Projects on electronic systems and energy harvesting.
2013 *Ph.D. dissertation committee member*, University of Zagreb, Croatia
2010-2014 Scientific Advisory Board of KissMyBike srl, Startup on IoT device and services, Italy
2008-Today Reviewer for several Journal: Microelectronics J. (since 2008), IEEE-TIE (since 2010), ACM-TECS, IEEE-Very Large Scale Integration Systems (since 2010), IEEE-TPELS (since 2011), IEEE-TC (since 2010), ACM-TOSN (since 2009), IEEE-TII (since 2011), IEEE-TIM (2009).

Memberships of Scientific and Professional Societies
- Member, Research Network "EIT - European Institute of Innovation & Technology" (since 2010)
- Member, Research Network "EMSIG : EMbedded Systems Special Interest Group." (since 2012)
- Founding member of the Italian Association of Tenured-track Assistant Professors (since 2010)
- Senior Member of IEEE (since 2016)
- Member of the IEEE Circuit & Systems, Solid State Circuits and Computer Societies. (since 2014)
- Member ACM (since 2014)

Research activities

I have always worked in top research groups and I have been an independent scientist and educator for 10 years when I moved to University of Trento as an Assistant Professor. My research interests are on computing systems architecture with special emphasis on low-power applications and embedded systems. I am also active in the design of energy-efficient ambient intelligence systems, sensors and sensor networks. I lead a research group with 6 staff members (Post-docs and PhDs) in university of Trento (UNITN).
With my collaborators, I made several contributions to the field of runtime power management, as well as integrated micro-sensors and energy-neutral, autonomous distributed sensing systems. On these topics, I coauthored more than **190** peer-reviewed papers. I strongly believe in collaborative, multi-disciplinary research: my scientific career has an extensive track record of international cooperation with top institutions like ETHZ, EPFL, U. Southampton, Tyndall Inst., Imperial College, University of Zagreb, Georgia Tech U.

Impact of the scientific contributions

- Energy Harvesting technologies. I have been one of the early contributors in this area, with some pioneering works since 2006, now with hundreds of citations. The work was not only focused on hardware methods for energy conversion from unregulated power source, but also in the first research on real-time scheduling in platforms with energy harvesters.
- Energy efficient digital architectures. I developed techniques for reducing the power consumption in low resources embedded systems for wireless sensor networks. I pioneered the first research investigation about streaming voice over wireless Zigbee channels in an energy efficient manner.
- Environmentally powered distributed sensing systems. In this area, I developed high-efficiency wireless senor nodes in various application domains from augmented reality to e-health. My work inspired several industrial prototypes, a patent jointly submitted with the biggest Italian telco company, and a start-up: MyPower Ltd (UK) (as a co-founder).

Impact of publications

- H-index = 39 (Extracted on Sept 1st 2019, from Google Scholar using Publish or Perish 7)
- G-index = 65 (Extracted on Sept 1st 2019, from Google Scholar using Publish or Perish 7)

Evidence of inspiring researchers

Several of my former graduate students won several international prizes or grants. Among these:
- **Maurizio Rossi,** won a 2-years post-doc position funded by Autonomous Province of Trento (Italy).
- **Parian Golchin** and **Brook Belay** won two research grants from IEEE Smart City Initiative.
- **Clemente Villani,** won the first prize as best master thesis at the Italian Innovation Design contest 2015.
- **Pietro Tosato,** won the Texas Instruments Innovation Challenge (TIIC) 2016, design contest for graduates.
- **Luca Tessaro**, won 2018 IEEE-ABB master thesis award on New Challenges for Energy and Industry

Fundraising and collaborative project (selected)**.**

1. IoT Proto Lab, ERASMUS+ initiative (Principal Investigatore, 100K€) 2019
2. *Embedded hardware technologies for IoT.* EIT-Digital (coordinator 100K€) 2017
2. FP7-ICT-2013.6.2 - n.609000 - *GreenDataNet* 4,3M€ (Head of Unit with my research team 353K€) 2013
3. *EnerViS - Energy Autonomous Low Power Vision*. Trento research agency (coordinator, 150K€) 2012
4. FP7-ICT-2009.3.5 - n. 257916 - *GENESI project* 3M€ (Work package leader 254K€) 2010
5. FP7-2010-NMP-ENV-ENERGY-ICT-EeB - n. 260162 - *3ENCULT* 6,7M€ (WP leader 370K€) 2010
6. ENIAC-JU n. 120214 - END – Models and Methods for Energy-Aware Design (Participant 300K€) 2010
7. FP7-ICT-2007.3.3 - n. 214373 - *ARTISTDesign - Network of Excellence* (Participant) 2010-2013
8. FP7-ICT-2007-2 - n. 224053 - *CoNET - Network of Excellence* (Participant) 2011-2012
9. FP7-ICT-2007.3.1 - n.216537 - *REALITY* - (Participant) 2009

Major Collaborations

- Prof. Vedran Bilas, Wakeup Radio and Energy Harvesting, Univ. of Zagreb (HR),
- Prof. David Atienza, Energy harvesting and compressive sensing EPFL (CH),
- Prof. Luca Benini, Ultralow power devices, ETH Zurich (CH),
- Prof. Leandro Lorenzelli, Microbial Fuel Cells, Fondazione Bruno Kessler (IT),
- Prof. Chiara Petrioli, Energy autonomous WSN, Università La Sapienza (IT),
- Prof. Geoff Merrett, Energy harvesting, University of Southampton (UK),
- Prof. Carlotta Guiducci, Sensing and circuits for energy harvesting, EPFL (CH),
- Prof. Mary Ann Weitnauer, Energy radio management, Georgia Tech (US),
- Dr. Emanuel Popovici, Energy Harvesting, University College Cork (IE),
- Dr. David Boyle, Low power management of circuits, Imperial College (UK),

Davide Brunelli

Early achievements track-record

I have published (international, peer-reviewed) **37 journal papers, 122 conference papers** and **5 chapters** in collective volumes. My **h-index** is **35**, **g-index** is **57** (from Google Scholar, on Feb 1st, 2018).
I collaborated with more than 120 different co-authors from top universities and research institutes all over the world.
I wrote more than **80 articles**, without my PhD supervisor, and I achieved remarkable scientific results in various research areas, by **leading my own research group in University of Trento**.

Top 10 publications in the last ten years, sorted in citations order first (citations from Google Scholar).
1. **D. Brunelli,** C. Moser, L. Thiele, L. Benini. *Design of a solar-harvesting circuit for batteryless embedded systems.* IEEE Trans. on Circuits and Systems I: Regular Papers, 56 (11), pp. 2519-2528, 2009 (**223 citations**). *This paper presents one of the first prototypes of submilliwat energy harvesters realized in literature, opening the pioneering research on energy neutral circuits. I was the first author, I did this research it during my PhD and I carried out most of the research activity.*

2. D. Dondi, **D. Brunelli**, A. Bertacchini, L. Larcher, L. Benini, *Modeling and Optimization of a Solar Energy Harvester System for Self-Powered Wireless Sensor Networks*, IEEE Trans. On Industrial Electronics, vol. 55, no. 7, pp. 2759 – 2766, 2008 (**296 citations**). *This paper presents techniques for optimizing power transfer efficiency in photovoltaic-powered wireless sensor nodes. I carried out the research in conjunction with Modena U. The harvester designed and prototyped achieved the highest published efficiency for small-scale photovoltaic harvesters.*

3. C. Caione, **D. Brunelli**, L. Benini. *Distributed compressive sampling for lifetime optimization in dense wireless sensor networks.* IEEE Transactions on Industrial Informatics, 8 (1), pp. 30-40, 2012. (**159 citations**). *This work used in practice another ground-breaking technology for minimising power consumption in signal processing applicaitons. We were among the firsts in literature to analyse the potentiality and to actually implement Compressive Sensing in a distributed way over a very large Wireless Sensor Network.*

4. D. Porcarelli, D. Balsamo, G. Paci, **D. Brunelli**. *Perpetual and low-cost power meter for monitoring residential and industrial appliances*. In Proceedings IEEE/ACM Design, Automation and Test in Europe, DATE, pp. 1155-1160. (**48 citations**). *This paper presents the first prototype of a completely energy-neutral power meter, which exploits the coupling elements of the current sensors to harvest the energy. It operates without any physical contact to the wire under measurement. I led the research team from UNIBO.*

5. M. Rossi, L. Rizzon, M. Fait, R. Passerone, **D. Brunelli**. *Energy neutral wireless sensing for server farms monitoring.* IEEE Journal on Emerging and Selected Topics in Circuits and Systems, 4 (3), pp. 324-334, 2014. (**26 citations**). *This papers investigate the possibility to reuse the energy dissipated as a heat by the heat-sinks on the top of high performance processors, for powering small ultra-low power sensors. I was the senior author and lead the research of my group in University of Trento.*

6**. D. Brunelli**, C. Caione. *Sparse recovery optimization in wireless sensor networks with a sub-nyquist sampling rate*. Sensors, 15 (7), pp. 16654-16673, 2015. (**22 citations**). *This work investigated the tradeoff between using Compressive Sensing to save power and the accuracy of the reconstruction.*

7. **D. Brunelli**, M. Rossi. *Enhancing lifetime of WSN for natural gas leakages detection*. Microelectronics Journal, 45 (12), pp. 1665-1670, 2014. (**17 citations**). *This paper presents an innovative method for measuring gas from MOX sensor, using transient analysis. The approach I proposed saves 20x the energy in comparison of the classics MOX device. I guided the research of my PhD student.*

8. **D. Brunelli**, E. Farella, D. Giovanelli, B. Milosevic, I. Minakov. *Design considerations for wireless acquisition of multichannel sEMG signals in prosthetic hand control.* IEEE Sensors Journal, 16 (23), pp. 8338-8347, 2016. *I was the first contributor of this paper and I was also the research leader of the activity which concerns the design of an ultra-low power device for real-time analysis of sEMG signals. The device was targeted to be extremely inexpensive and still guaranteeing accuracy of the signal processing.*

9. M. Rossi, D. **Brunelli, D.** *Autonomous gas detection and mapping with unmanned aerial vehicles,* IEEE Transactions on Instrumentation and Measurement, 65 (4), pp. 765-775, 2016. *This is another pioneering work*

that I lead in my research group in UNITN. We were among the first in the literature to make experiments with gas sensors on-board of UAV, and to develop a self-driving system for the drones targeted at finding the gas leakages.

10. **D. Brunelli**, P. Tosato, M. Rossi. *Flora Health Wireless Monitoring with Plant-Microbial Fuel Cell*. Procedia Engineering, 168, pp. 1646-1650, 2017. *This is a very recent work which demonstrates the feasibility of the research I am proposing in this ERC. The paper shows how a Plant-Microbial Fuel Cell can be used both as a power generator for a smart wireless sensing circuit, and as sensor for assessing the health of the plant. I was the initiator of this idea and I'm currently leading the activity with my top PhD students.*

Chapters in collective volumes in the last 10 years (5 out of 8)
1. C. Moser, D. Brunelli, L. Thiele, L. Benini. *Lazy Scheduling for Energy Harvesting Sensor Nodes*. In *From Model-Driven Design to Resource Management for Distributed Embedded Systems*, Springer 2008.
2. Brunelli, D., et al. . *Energy autonomous low power vision system.* In *Lecture Notes in Electrical Engineering,* Springer 2014.
3. Vinco, A., Siddique, R., Brunelli, D. *AA-battery sized energy harvesting power management module for indoor light wireless sensor applications.* In *Lecture Notes in Electrical Engineering,* Springer 2016.
4. Brunelli, D., Magno, M., Porcarelli, D., Benini, L. *A multi harvester with hydrogen fuel cell for outdoor applications.* In *Lecture Notes in Electrical Engineering,* Springer 2014.
5. D. Brunelli, L. Tamburini, M. Rossi. *Electronic and ICT solutions for smart buildings and urban areas.* Handbook of Research on Social, Economic, and Environmental Sustainability in the Development of Smart Cities, pp. 165-192, 2015.

Patent
1. D. Brunelli, D. Balsamo, V. Bella (2016). Meter apparatus for measuring parameters of electrical quantity. Application PCT/EP2016/062303

Invited talks and organization of international conferences
1. Invited Speech. *IEEE International Workshop on Industry 4.0 & Internet of Things,* Rome 2017
2. Invited Speech. *IEEE International Conference on VLSI and System-on-Chip*, VLSI-Soc, Madrid 2010
3. Invited Speech. *ACROSS Workshop on Cooperative Networked Embedded Systems*, Zagreb 2013;
4. Invited lecture. *Summer School on Wireless Body Sensor Networks (B-AWARE)*, EPFL, Lausanne 2011.
5. ACM *ENSSYS (Energy Neutral Sensing Systems).* General Co-Chair, 2013.
6. ACM *ENSSYS (Energy Neutral Sensing Systems).* Program Co-Chair, 2014 and 2015.
7. ACM/IEEE *DATE (Design Automation and Test Europe).* Topic Chair 2010-2016.
8. IEEE *IoENT (Internet of Energy Neutral Things)*. General Co-Chair, 2017
9. *UCAmI, (Conference on Ubiquitous Computing and Ambient Intelligence)* 2012, Program Co-Chair.
10. ACM *Mobicase (Int. Conference on Mobile Computing Applications)* 2011, Workshop Chair

International Prizes / Awards:
1. Winner of the *Texas Instruments Innovation Contest*, as advising professor. 2016. "A long range monitoring system powered by Terrestrial Microbial Fuel Cell". *I lead a group of 5 top students attending my course, and we demonstrated that it is possible to power a microcontroller using the energy generated by bacteria colony in the soil. Texas Instruments awarded the project with 6000€*
2. *Best Paper Award* in IEEE International Conference on Intelligent Sensors, Sensor Networks and Information Processing IEEE-ISSNIP (2011)
3. *Best Paper Award* IEEE International Workshop on Practical Issues in Building Sensor Network Applications IEEE SENSEAPP (2014)
4. Winner of the (Lamark Prize) for "AroundYou: smart sensor platforms for the Internet of Things" (2014)
5. Best Poster award Electronics Association group (Italy section) 2016, for "IoT-ready precision agriculture powered by microbial fuel-cells"

Member of Editorial boards
1. MDPI Sensors journal (ISSN 1424-8220), *Associate Editor*, 2014- present.
2. International Journal of Distributed Sensors Networks (ISSN 1550-1477), *Associate Editor*, 2011-present.