

Giacomo Boracchi

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Highlights

- Assistant professor (tenure track) at Dipartimento di Elettronica e Informazione e Bioingegneria (DEIB), Politecnico di Milano since May 2014; 7 years post-doctoral research experience.
- National Habilitation 09/H1 “SISTEMI DI ELABORAZIONE DELLE INFORMAZIONI, Professore Seconda Fascia”. December 2016.
- My research interests encompass two different areas: *image processing* and *machine learning*. My most important contributions address methods for image restoration, computational imaging, change/anomaly detection and learning in nonstationary environments. These have been published in top journals of the respective fields, namely IEEE Trans. on Image Processing, International Journal of Computer Vision (Springer) and Trans. on Neural Networks and Learning Systems, Neural Networks (Elsevier).
- Publications: 18 papers in peer-reviewed international journals (including 13 in Class 1 according to ANVUR ING-INF/05 and 1 single-author publication in Class 2), 4 book chapters, 39 conference and 7 workshop papers. H-index: 18 (1104 cit. in Google Scholar, March 2019). Academic age: 12y.
- IEEE Trans. on Neural Networks and Learning Systems Outstanding Paper Award 2016: Cesare Alippi, Giacomo Boracchi and Manuel Roveri “*Just In Time Classifiers for Recurrent Concepts*” (class 1 journal in ANVUR ING-INF/05).
- IBM Faculty Award 2015, *Anomaly Detection in Anatomical Brain Images by Sparse Representations*.
- Research projects:
 - *Project Leader* of industrial research projects with Gilardoni Raggi X S.p.A, (leader in manufacturing of X-ray and ultrasound equipment) for designing advanced baggage-inspection systems for airport security (2015- 2018), and with Cleafy s.r.l. for detecting anomalies in web accesses.
 - *Principal Investigator*, since 2008, of industrial projects between DEIB and Gilardoni Raggi X, and in the regional-funded project “Checkpoint Integrato” (2012 -2014).
 - *Research Scientist* in the EU-funded project “iSense” (2011 - 2013), and in two projects funded by the Academy of Finland (2008 - 2012 and 2011 - 2016).
- *Supervisor* of 2 PhD grants sponsored by STMicroelectronics (2016 - 2018, 2019 - 2021) and 1 Interdisciplinary PhD grant sponsored by Polimi (2018 - 2020). Supervisor of about 20 MSc thesis students.
- Overall fund raising: $\approx 500K$ €.
- Established research collaborations with the Laboratory of Signal Processing (Tampere University, Finland), the Theoretical Division of Los Alamos National Laboratory (LANL, NM USA), and the Machine Learning Group at Université Libre de Bruxelles (ULB, Belgium). Research visits at TUT and ULB.
- Teaching in Politecnico di Milano. PhD courses: *Image Classification* (2018) and *Learning Sparse Representations for Image and Signal Modeling* (2017, 2019). MSc courses *Informatica A* (since 2018), *Informatica B* (2012 -2018).
- Associate editor in IEEE Transactions on Image Processing (November 2018) and IEEE Computational Intelligence Magazine (January 2019). Guest Editor of two special issues (IEEE CIM 2016, NCAA Springer 2018).

Positions and Education

RECORD OF EMPLOYMENT

September 2016 – present

Assistant Professor (*Ricercatore RTD-b*, tenure track) at Dipartimento di Elettronica, Informazione e Bioingegneria of Politecnico di Milano, Milano, Italy. System Architecture Group.

May 2014 – September 2016

Assistant Professor (*Ricercatore RTD-a*) at Dipartimento di Elettronica, Informazione e Bioingegneria of Politecnico di Milano, Milano, Italy. System Architecture Group.

September 2012 – April 2014

Teaching computer science as a professor during the academic years 2012/13 and 2013/14.

March 2008 – April 2014

Postdoctoral Researcher (“assegnista di ricerca”) at DEI, Politecnico di Milano:

- “*Intelligent mechanisms for the identification and classification of faults and nonstationarities in sensor/actuator networks*” (March 2012 – April 2014)
- “*Design and development of algorithms for detecting non-stationarities in signals and images*” (March 2011 – February 2012).
- “*Design and development of reconstruction algorithms for multiview, possibly calibrated, imaging systems*” (March 2008 – February 2011).

March 2005 – February 2008

PhD student at Dipartimento di Elettronica e Informazione of Politecnico di Milano, Milano, Italy.

September 2004 – February 2005

Researcher at TICSP, Tampere International Centre for Signal Processing, Tampere, Finland, working on “*Adaptive Filtering Techniques for Image Denoising*”.

EDUCATION

- European PhD in Information Technology at Politecnico di Milano, Milano, Italy. May 2008.
Title: “*Motion Blur: Analysis and Restoration*”.
Advisor: *V. Caglioti* (Politecnico di Milano).
Reviewers: *A. Gotchev* (Tampere University of Technology) and *R. Creutzburg* (Brandenburg University of Applied Sciences).
- M.Sc. in Mathematics, at Università degli Studi di Milano, Milano, Italy. April 2004. Grade: 108/110.
Title: “*Biorthogonal Wavelet Basis and The Lifting Scheme in $L^2(\mathbb{R})$* ”.
Advisor: *M. Salvatori*
- Scientific high school diploma from Liceo Scientifico G.B. Vico, Corsico, (Milano), Italy. July 1998.

MAIN RESEARCH VISITS

- Visiting Research Fellow at Computational Imaging Group, Tampere University of Technology (June 2016 - July 2016).
- Research Visit at Machine Learning Group of Université Libre de Bruxelles (September 2015).

- Visiting Research Fellow at Computational Imaging Group, Tampere University of Technology (July 2013 - August 2013).
- Visiting PhD student at Computational Imaging Group, Tampere University of Technology (July 2007 - October 2007).

Since 2008, I regularly visit the Computational Imaging Group at Tampere University of Technology for research collaborations concerning computational imaging and image/video restoration algorithms.

Awards and Grants

HABILITATIONS

- HA.1. **National Habilitation as Associate Professor** Sector: 09/H1 “SISTEMI DI ELABORAZIONE DELLE INFORMAZIONI, Professore Seconda Fascia”. December 2016.

AWARDS

- AW.1. **IEEE Transactions on Neural Networks and Learning Systems Outstanding Paper Award 2016** [JR.11]
Cesare Alippi, Giacomo Boracchi and Manuel Roveri “Just In Time Classifiers for Recurrent Concepts“ *IEEE Transactions on Neural Networks and Learning Systems*, vol. 24, no. 4, April 2013, pp. 620 - 634 (TNNLS is a class 1 journal in ANVUR ING-INF/05 and ranked 8 among IEEE journals according to impact factor).
- AW.2. **Best Regular Paper Award** INNS Conference on Big Data 2016 [JR.11]
Cesare Alippi, Giacomo Boracchi and Diego Carrera “CCM: Controlling the Change Magnitude in High Dimensional Data”, *Proceedings of 2nd INNS Conference on Big Data*, October 23-25, 2016, Thessaloniki, Greece, 10 pages
- AW.3. **IBM Faculty Award 2015**
Project Title: *Anomaly Detection in Anatomical Brain Images by Sparse Representations*, Giacomo Boracchi (12K \$).

GRANTS AND SCHOLARSHIPS

- GR.1. **Epic Expert Visits:** grant to support a research visit in Auckland University of Technology (New Zealand) concerning *sequential monitoring schemes in transformed domain* during 2019, 2K €.
- GR.2. **nVidia Hardware Grant:** donation of a Titan V GPU to support our research on data-driven algorithms for analyzing seismocardiogram (2018), permutation tests (2017) and a Tesla K40 GPU to support our research on anomaly detection in images (2015).
- GR.3. **Nokia Visiting Professor:** grant to support a research visit in TUT (Finland) during 2017. Project title: *Foveated Image Features*, Giacomo Boracchi . 6K €.
- GR.4. **CIMO grant** from Center for International Mobility (CIMO), Finland during July 2007 - October 2007 4.8K €.
- GR.5. **INTAS travel grant** for attending at the 16th Jyväskylä Summer School, Jyväskylä, Finland (July 2006).
- GR.6. **MIUR Scholarship** for covering PhD studies from March 2005 until February 2008.

Research Interests

My research encompasses two different areas: *computational intelligence* and *image analysis*. In particular, my research in computational intelligence focuses on learning methods for nonstationary environments and their use in the design of intelligent systems. My research in image analysis concerns computational imaging and statistical methods for image analysis/enhancement.

LEARNING IN NONSTATIONARY ENVIRONMENTS AND INTELLIGENT SYSTEMS

In the real-world, data often arrive in the form of streams and the process generating them might be nonstationary, i.e., might change over time. Nonstationarities can be due to uncontrollable evolutions of the environment (e.g., in fraud detection, the stream of credit-card transactions continuously change, following customer habits and new fraudulent activities) or unpredictable events (e.g., faults affecting measurements acquired in industrial or environmental monitoring applications). Thus, in nonstationary environments (NSE), systems leveraging data-driven models have to address learning problems that necessarily involve adaptation. Learning in NSE raises theoretical, methodological and practical research challenges: my major contributions concern the following research directions and their applications in the design of intelligent systems.

- **Learning in NSE and the Just-in-time (JIT) Adaptation:** Data-driven models (like classifiers) can not be straightforwardly used in a NSE. In fact, training and test data might come from two different distributions, and some form of adaptation is necessary to keep the learned model up-to-date and effective.

We have proposed a new methodology to learn in NSEs: the JIT approach. JIT systems implement a *detection - adaptation* paradigm: detection is performed by change-detection tests that steadily monitor the input datastream, while adaptation is achieved by specific post-detection procedures that identify, after each detected change, a suitable training set and autonomously adapt to the new process state (i.e., the new concept). One option to gather new training samples is to retrospectively analyze the recent data and estimate the change-time instant: data in between the change-time and the detection-time are from the new concept. To this purpose, we proposed an iterative algorithm [IC.30] and an ensemble of change-point methods [JR.12] that provides accurate estimates of the change-time instant when data exhibit some form of correlation. Another option to recover training samples is to identify which of the previously encountered concepts is equivalent to the new one, and we addressed this problem in [JR.11] [AW.1] by designing either computational representations for concepts and operators to assess their equivalence.

We considered classification as a relevant example of learning problem [IB.1] and introduced a general methodology for designing JIT classifiers [JR.15], which was further developed in [JR.11] to handle recurrent concepts. JIT classifiers specifically designed for gradually drifting processes are in [IC.28], [IC.32]. We are currently investigating learning strategies to address other challenges often affecting – on top of concept drift – real world data streams, namely class unbalance and sampling selection bias. A prominent example is credit-card fraud-detection, that we addressed in [IC.11], [JR.3].

- **Change-detection tests (CDTs):** namely, algorithms that analyze datastreams and detect changes in the data-generating process. One of the most challenging problems in the change-detection literature is the detection of changes in a stream of i.i.d. data when the pre- and post-change distributions are unknown (nonparametric monitoring). In this direction we have designed a family of nonparametric CDTs [IC.31], [JR.15] based on the Intersection of Confidence Intervals (ICI) rule, which has been also customized for Bernoulli sequences [IC.20] and for distributed systems [IC.24]. We have also introduced hierarchical CDTs [JR.6] that, like emotional processes of human brain, perform an high-level validation of each detection. Hierarchical CDTs typically outperform traditional nonparametric CDTs, achieving similar detection performance at lower false-alarm rate. Currently, we are investigating the intrinsic challenges of change-detection when input data dimension scales [IC.7].

Most of our theoretical results have been customized to design algorithms for intelligent systems: smart cameras of wireless sensor networks that can detect tampering attacks [JR.17], [IC.10], smart buildings that can detect contaminants [JR.8], leak-detection systems for water-distribution networks [IC.15]

- **Learning to detect:** Often, stationary data are characterized by peculiar structures and only changes modifying these structures have to be detected as anomalies. For instance, in sensor networks for rock-face monitoring, MEMS signals typically feature specific wave-like shapes: changes in these shapes have to be detected as forerunners of a collapse [IC.14] [JR.10]. Similarly, ECG tracings exhibit morphologies that characterize each patient: heartbeats having an anomalous morphology might indicate arrhythmias or electrodes misplacement [IC.6] [PT.2]. The same issues raise in image-analysis systems where anomaly detection is a primary concern: smart manufacturing systems [IC.8],[JR.5] and X-ray baggage-inspection systems for airport security, which we develop together with Gilardoni Raggi X. Unfortunately, traditional CDT/Outlier detection methods cannot be straightforwardly adopted, since they rely on random-variable models that are not adequate to describe structures characterizing normal data.

To overcome this problem we have developed a very promising approach that consists in learning a model yielding a sparse representation of normal data and then detecting as anomalous any data that can not be adequately described by the learned model. We presented solutions based on traditional sparse representations [IC.14], [IC.13], [PT.2], [JR.5] and on convolutional sparse representations [IC.12], which outperformed comparable anomaly-detection solutions. We are now developing further this approach by investigating advanced learning techniques to train models that are specifically designed for anomaly-detection purposes, as well as different priors like self-similarity [IC.15] to model normal data.

On this research line, STMicroelectronics has sponsored a grant titled “*Intelligent embedded systems for high-dimensional and high-complexity datastreams*”, to a PhD student that I am currently supervising. I have also received an IBM faculty award [AW.3] to support this research line and design image-analysis algorithms to monitor the progression of neurodegenerative conditions like Huntington’s disease.

IMAGE ANALYSIS AND PROCESSING

My research activity concerns statistical methods and algorithms for handling blur and noise in digital imaging. In particular, I have been addressing this problem both from a computational imaging perspective, designing acquisition strategies that ease the image-enhancement problem, and from an image-analysis and restoration perspective, designing algorithms to estimate and suppress these degradations.

- **Automatically defining the optimal exposure time:** In digital photography it is always possible to improve the signal-to-noise ratio of the acquired pictures by increasing the exposure time. However, this is not always a viable solution because of dynamic scenes or camera shakes that would introduce motion blur. In digital photography there is indeed a trade-off, ruled by the exposure time, between the amount of blur and noise. Such a trade-off becomes particularly evident at low-light conditions, where short exposure times yield images corrupted by an overwhelming noise, while long exposure times produce pictures dominated by blur. Even though the effectiveness of any restoration algorithm combining deblurring and denoising is significantly influenced by the exposure time, none of the existing cameras is able to autonomously set the exposure time in order to ease the restoration task.

We have been pioneering computational imaging solutions for determining the exposure time that maximizes the quality of the restored image. We have studied the uniform motion blur case [JR.16] through analytical derivations, and we presented a methodology for designing statistical models that predict the restoration performance in case of random motion (including camera shake) [JR.14]. These models can be used to determine the optimal exposure time. We have also investigated the effectiveness of denoising multiple short-exposure images, as an alternative to deblurring a long exposure one [WS.7].

- **Image and video restoration:** Assuming that natural images are self-similar (i.e., that their content is redundant), is the prior providing by far the largest potential for image/video restoration. Self-similarity is typically assessed in a nonlocal, patch-wise, manner, and many imaging algorithms extensively compare image patches by means of the weighted Euclidean distance. Inspired by the human visual system, we introduced the foveated patch-distance [JR.7] which mimics the inability of the human visual system to perceive details at the periphery. We have designed general foveation operators, and shown through extensive experiments that nonlocal image filters [JR.7], [IC.19], [WS.3] measuring the foveated distance outperform their conventional counterparts. Therefore, the foveated self-similarity yields a more effective regularization prior than the conventional Euclidean self-similarity. We are currently investigating new aggregation techniques to bring foveated self-similarity into state-of-the-art image-filtering algorithms.

We also proposed a powerful video filtering paradigm, VBM4D [JR.13], which exploits both temporal and spatial redundancy characterizing natural video sequences: VBM4D achieved state-of-the-art performance in video denoising. Customized denoising algorithms for X-ray multispectral images have been designed within the industrial research projects sponsored by Gilardoni Raggi X S.p.A.

- **Motion blur analysis:** Motion-blurred images embody information about the motion taking place during the acquisition. We devised accurate image-formation models and designed image-analysis algorithms such that a camera can estimate its own 3D motion by analyzing a single blurred image. In particular, we designed algorithms to estimate the 3D motion occurred during the acquisition of a radial-blurred image [JR.18], of a rotationally-blurred image [IC.34], and of a picture depicting a moving ball [IB.4]. These algorithms exploit ad-hoc techniques to adaptively select and analyze salient regions within the blurred images [IC.36]. We presented a deblurring algorithm for radial-blurred images [IC.33], which outperforms other solutions thanks to a spatially adaptive denoising step following the blur inversion. This research activity has been mainly carried out during my PhD.

External Research Collaborations

My research has benefited of the following collaborations with internationally renowned researchers:

- Prof. Alessandro Foi and the Computational Imaging Group at Tampere University of Technology (Finland). Our research on image/video processing and computational imaging has been also sponsored by Finnish national projects. Main outcomes: [JR.7], [JR.13], [JR.14], [JR.16].
- Brendt Wohlberg, PhD. from Los Alamos National Laboratory (NM, USA). Research on sparse representations and convolutional sparse models. Main outcomes: [IC.14], [IC.13], [IC.12], and a collaboration as Guest Editors in the special issue “*Model Complexity, Regularization and Sparsity*” of IEEE CIM (November 2016).
- Prof. Gianluca Bontempi and the Machine Learning Group from Université Libre de Bruxelles (Belgium). Research on machine-learning methods for fraud detection, concept-drift adaptation and sampling selection bias. Main outcomes: [IC.11], [TR.??], and I was co-supervising a PhD student from ULB during his visit at DEIB in November 2014 and April-May 2015.
- Guillermo Cecchi, PhD. IBM TJ Watson Lab (New York, USA). Research on anomaly-detection algorithms for automatically assessing the progression of neurodegenerative conditions like Huntington’s disease in brain images. Collaboration sponsored by IBM faculty award 2015 [AW.3].
- Pasqualina Fragneto, STMicroelectronics, (Italy). Collaboration on arrhythmia and anomaly detection for health monitoring and quality inspection.

- Cristiano Cervellera, PhD. from Institute Of Intelligent Systems For Automation, CNR (Italy). Research collaboration on unsupervised learning and change-detection for high-dimensional data.
- Prof. Vicenç Puig from Universitat Politècnica de Catalunya, (Spain). Research collaborations within the iSense project on leak/fault detection in water-distribution networks. Main outcomes: [IC.18], [WS.4].
- Michalis P. Michaelides, PhD. from Cyprus University of Technology (Cyprus). Research collaboration started within the iSense project on contaminant/fault detection in smart buildings. Main outcomes: [IC.16], [JR.8].
- Prof. Robi Polikar from Rowan University (NJ, USA). Research on learning in nonstationary environments. Main outcomes [IB.1] and three special sessions on “*Concept Drift, Domain Adaptation & Learning in Dynamic Environments*” jointly organized at IJCNN 2014, 2015 and 2016.
- Dr. Gregory Ditzler from University of Arizona (AZ, USA). Research on learning in nonstationary environments. Joint tutorial “*Learning in Nonstationary Environments: Perspectives and Applications*” at IEEE-SSCI 2015.
- Prof. Dongbin Zhang from Chinese Academy of Sciences (China). Research on change detection using encoding-decoding machines. Main outcome: [IB.2].
- Alessandro Giusti, PhD. from Dalle Molle Institute for Artificial Intelligence (Switzerland). Research on anomaly detection in biomedical imaging. Co-teaching the PhD Course “*Image Classification: Modern Approaches*”, in Polimi, DEIB 2018.
- Ettore Lanzarone, PhD. from Institute of Applied Mathematics and Information Technology, CNR (Italy). Research collaboration on anomaly detection for monitoring the industrial production of nanofibers by analyzing SEM images. Main outcomes: collaboration on AUTOSPIN project.

Scientific Activities and Services

RESEARCH PROJECTS

Gilardoni Raggi X

TYPE: Industrial research project between DEIB and Gilardoni Raggi X S.p.A.

DATE: 2015 - 2018

TOPIC: Design of an X-ray baggage-inspection system that achieves the new performance standards for airport controls. In particular, the project focuses on computational intelligence and image-processing algorithms for reducing false alarms.

ROLE: *Project Leader* and *Principal Investigator*. I am planning the research activity, coordinating a junior engineer employed at Gilardoni Raggi X, designing algorithms and experiments, developing efficient software prototypes. I wrote the project proposal.

PROJECT LEADER: Dr. Giacomo Boracchi.

STMicronics

TYPE: PhD Grant student sponsored by STMicronics

DATE: 2016 - 2018

TOPIC: Design of anomaly and change-detection algorithms for signals and images.

ROLE: *Project Leader* Our algorithms for ECG monitoring have been published in class A conferences (e.g. [IC.3]) and implemented in a prototype device. The anomaly-detection algorithms investigated are currently

being ported to monitor STMicroelectronics production.

PROJECT LEADER: Dr. Giacomo Boracchi.

Smart autonomous broadband laser light

TYPE: Academic, Finnish National

DATE: 2018 - 2019

TOPIC: Development of machine learning models to control and optimize lasers light emission characteristics

ROLE: *External Collaborator*, design of the networks architecture and transfer learning procedures.

LOCAL PROJECT LEADER: Prof. Göery Genty and Prof. Alessandro Foi.

High-performance filtering for scientific imaging

TYPE: Academic, Finnish National

DATE: 2011 - 2016

TOPIC: Development of high-quality image enhancement algorithms for scientific imaging.

ROLE: *Research scientist*, contributing in the investigation of image formation models and the design of image denoising algorithms. In particular, my research focus on image models inspired by the human-visual system, and in particular on the role of foveation in image filtering.

LOCAL PROJECT LEADER: Prof. Alessandro Foi, Tampere University of Technology.

Automated electrospinning plant for industrial manufacturing of functional composite nanofibres (AUTOSPIN)

TYPE: National (CNR and MIUR)

DATE: 2016

TOPIC: Advanced system for monitoring the industrial production of nanofibers.

ROLE: *Collaborator*, design of the anomaly-detection algorithm for SEM images.

LOCAL PROJECT LEADER: Dr. Ettore Lanzarone, CNR, IMATI.

Checkpoint Integrato

TYPE: Industrial, Regional and National Funding

DATE: 2012 - 2014

TOPIC: Design of a new generation checkpoint for security controls. This checkpoint augments X-ray inspection technologies with computer vision and multi-energy X-ray detectors.

ROLE: *Principal Investigator* of the research concerning the detection system in the X-ray baggage-scanning machine. I have planned and coordinated the research activities, designed the algorithms and experimental campaign, developed software prototypes and discussed the research outcomes with Gilardoni Raggi X staff. Since May 2013 I am supervising a junior engineer employed at Gilardoni Raggi X. I have also contributed in the proposal and technical report preparation.

LOCAL PROJECT LEADER: Prof. Cesare Alippi.

Gilardoni Raggi X

TYPE: Industrial research project between DEIB and Gilardoni Raggi X S.p.A.

DATE: 2008 - 2013

TOPIC: Design of image processing and computational intelligence algorithms to enhance X-ray baggage-inspection systems. In particular, investigating neural models to identify materials from their X-ray absorption (inverse problem), and designing customized algorithms for image enhancement and segmentation.

ROLE: *Principal Investigator*, responsible of the research. I have been designing algorithm and the preparatory experiments, developing software prototypes, preparing technical reports and I was presenting the results and discussing future research directions with Gilardoni Raggi X staff.

LOCAL PROJECT LEADER: Prof. Cesare Alippi.

iSense

TYPE: Academic, European

DATE: 2011 - 2013

TOPIC: Development of intelligent data processing methods for fault detection, isolation and identification.

ROLE: *Research Scientist*, investigating computational intelligence algorithms to automatically detect and diagnose faults in critical systems such as: water-distribution networks, environmental monitoring systems and smart buildings.

LOCAL PROJECT LEADER: Prof. Cesare Alippi.

Non-local modeling of images and vision for compressive sensing and inverse imaging

TYPE: Academic, Finnish National

DATE: 2008 - 2012

TOPIC: Development of non-local image-processing algorithms for compressive sensing and inverse imaging.

ROLE: *Research Scientist*, investigating models to describe how the restoration quality varies with the exposure time in presence of motion. These models allow to automatically define, before image acquisition starts, the exposure time that maximizes the effectiveness of digital image restoration.

PROJECT LEADER: Prof. Alessandro Foi, Tampere University of Technology.

FUND RAISING

Gilardoni Raggi X: Project grant, 2015 - 2018, 225K €.

Cleafy: Project grant, 2018, 35K €.

Polimi: Inter-doctoral PhD scholarship, titled “*Computational Fluid Dynamic and Machine Learning for Diagnosing Complex Systems*”, 2018 - 2020, 70K €

ST Microelectronics: PhD scholarship, titled “*Advanced Learning Methods for Anomaly Detection in Signals and Images*”, 2016 - 2018, 70K €

PhD scholarship, titled “*Intelligent embedded systems for high-dimensional and high-complexity datastreams*”, 2016 - 2018, 70K €

IBM Faculty Award: project titled “*Anomaly Detection in Anatomical Brain Images by Sparse Representations*”, 2015 12K \$

Collaboration with T&O 2017 - 2018 about image recognition, 27K €

Collaboration with MecTho 2017 about image classification, 20K €

Collaboration with IMATI, CNR: on “*Autospin*” project, 2016, 4K €

CONFERENCE ORGANIZATION COMMITTEES

- Program Co-chair “*18th International Conference on Engineering Applications of Neural Networks*” (EANN) 2017.
- Special Session Chair at “*Artificial Intelligence Applications and Innovations Conference*” (AIAI) 2016.
- Publicity co-chair at “*IEEE-INNS Int. Joint Conference on Neural Networks*” (IEEE-INNS IJCNN) 2015.
- Co-organizer of the mini-symposium “*Recent Advances in Convolutional Sparse Representations*” at Siam Imaging Science, 2018.
- Co-organizer of the symposium “*Intelligence for Embedded and Cyberphysical Systems*” in IEEE Symposium Series in Computational Intelligence (IEEE SSCI) 2016, 2015.
- Co-organizer of the special session “*Concept Drift, Domain Adaptation & Learning in Dynamic Environments*” at IEEE-INNS IJCNN 2017, 2016, 2015, and 2014.

- Co-organizer of the special session “*Sequential Learning with Neural Networks*” at IEEE-INNS IJCNN 2016.
- Co-organizer of the symposium “*Intelligent Embedded Systems*” (IES) at IEEE SSCI 2014.
- Co-organizer of the workshop on “*Learning strategies and data processing in nonstationary environments*” at AIAI 2013.
- Co-organizer of special session “*Intelligent Embedded Systems*” at IEEE IJCNN 2013 and 2012.
- Local Chair for the “*IEEE Haptic Audio-Visual Environment and Games*” (IEEE HAVE) 2009.

PROGRAM COMMITTEE MEMBERSHIP

I was part in the TPC of the following scientific events:

- Senior TPC member in “*Int. Joint Conference on Artificial Intelligence*”, IJCAI 2019.
- “*IEEE-INNS Int. Joint Conference on Neural Networks*”, (IEEE-INNS IJCNN) in 2016, 2015 and 2014.
- “*IEEE World Congress on Intelligent Control and Automation*”, (IEEE WCICA 2016) in 2016.
- “*Int. Joint Conference on Artificial Intelligence*”, IJCAI 2015.
- “*Image Processing: Algorithms and Systems*” at IS&T Electronic Imaging, 2017- 2014.
- “*IEEE Int. Instrumentation and Measurement Technology Conference*” (I2MTC), 2016 and 2015.
- “*Int. Workshop on Computational Energy Management in Smart Grids*” 2016 and 2015.
- “*5th Int. Conference on Information Science and Technology*” (ICIST), 2015.
- “*3rd Int. Symposium on Learning and Data Sciences*” (SLDS), 2015.
- “*Int. Conf. on Intelligent Control and Information Processing*”, (ICICIP) 2013.
- “*Int. Conf. on Artificial Intelligence Applications and Innovations*” (AIAI) 2013 and 2010.

Editorial Activities

ASSOCIATE EDITOR

- Associate Editor in IEEE Transactions on Image Processing, since November 2018.
- Associate Editor in IEEE Computational Intelligence Magazine, since January 2019.

GUEST EDITOR

- Guest Editor in the Special Issue of selected papers at EANN 2017, Neural Computing and Applications, Springer, 2018.
- Guest Editor in the Special Issue on “*Model Complexity, Regularization and Sparsity*”, IEEE Computational Intelligence Magazine, November 2016.

REFERRING SERVICES

I have been serving as a reviewer for the following international journals:

- IEEE Transactions on Neural Networks and Learning Systems.
- IEEE Transactions on Neural Networks.
- IEEE Transactions on Image Processing.
- IEEE Transactions on Computational Imaging.

- IEEE Transactions on Circuits and Systems for Video Technology.
- IEEE Transactions on Instrumentation and Measurement.
- IEEE Transactions on Signal Processing.
- IEEE Transactions on Emerging Topics in Computational Intelligence
- IEEE Signal Processing Letters.
- IEEE Embedded Systems Letters.
- Pattern Recognition, Elsevier.
- Neural Networks, Elsevier.
- Neurocomputing, Elsevier.
- Pattern Recognition Letters, Elsevier.
- Computer & Graphics, Elsevier.
- Engineering Applications of Artificial Intelligence, Elsevier.
- International Journal of Computer Vision, Springer.
- Journal of Mathematical Imaging and Vision, Springer.
- Multimedia Systems, Springer.
- Medical & Biological Engineering & Computing, Springer
- SIAM Journal on Imaging Sciences, SIAM.
- Optical Engineering, SPIE.
- Science, Measurement & Technology, IET.
- Computer Science & Technology, IET.
- Image Processing, IET.
- Journal of Electronic Imaging, SPIE and IS&T.

I have been serving as a reviewer for the following international conferences:

- “*IEEE-INNS Int. Joint Conference on Neural Networks*”, (IEEE-INNS IJCNN) in 2010 - 2018.
- “*IEEE Int. Conference on Acoustics, Speech and Signal Processing*” (IEEE ICASSP) in 2013 - 2018.
- “*IEEE Int. Conference on Image Processing*” (IEEE ICIP) 2015 - 2016.
- “*European Symposium on Artificial Neural Networks*” (ESANN) in 2016.
- “*IEEE Symposium Series in Computational Intelligence*” (IEEE SSCI) in 2014 and 2012.
- “*Image Processing: Algorithms and Systems XII*” at Electronic Imaging, (EI) 2014.
- “*European Signal Processing Conference*”, (EUSIPCO) 2014 and 2012.
- “*Int. Conference on Neural Computation Theory and Applications*” (NCTA) 2013.
- “*Int. Symposium on Neural Networks*”, (ISNN) 2011.
- “*Int. Conference on Artificial Neural Networks*”, (ICANN) in 2010, 2009.
- “*Int. Conference on Intelligent Systems Design and Applications*”, (ISDA) 2010.
- “*Int. Workshop on Local and Non-Local Approximation in Image Processing*” in 2009, 2008.

Talks and Tutorials

TUTORIALS

- “*Change and Anomaly Detection in Signal, Images, and General Data Streams*” at IEEE International Conference of Acoustic Speech and Signal Processing, ICASSP 2018.

- “*Learning class imbalanced data streams*” at International Joint Conference on Neural Networks, IEEE WCCI IJCNN 2018 Rio de Janeiro, Brazil
- “*Change and Anomaly Detection in Data Streams*” at International Joint Conference on Neural Networks, IJCNN 2017.
- “*Change Detection in Data Streams: Big Data Challenges*” at INNS Conference on Big Data, 2016.
- “*Learning in Nonstationary Environments: Perspectives and Applications*” at IEEE Symposium Series on Computational Intelligence (IEEE SSCI 2015) together with Gregory Ditzler from University of Arizona.
- “*Learning Under Concept Drift: Methodologies and Applications*” at 16th International Conference on Engineering Applications of Neural Networks (EANN 2015).

TALKS

- “Change Detection in Multivariate Datastreams: Likelihood and Detectability Loss” at Tampere University of Technology, Tampere, Finland, May 2016.
- “Just-in-Time Classifiers for Recurrent Concepts” at Université Libre de Bruxelles, Bruxelles, Belgium, September 2015.
- “Anomaly Detection with Sparse Representations” at Dalle Molle Institute for Artificial Intelligence, Lugano, Switzerland, December 2014.
- “Change and Anomaly Detection by Means of Sparse Representations” at Tampere University of Technology, Tampere, Finland, September 2014.
- “Foveated self-similarity in nonlocal image filtering” at Università della Svizzera Italiana, Lugano, Switzerland, September 2013.
- “A Brief Overview on Change Point Methods” at Tampere University of Technology, Tampere, Finland, April 2013.
- “Distributed Change-Detection Test in Wireless Sensor Networks” at Tampere University of Technology, Tampere, Finland, June 2012.
- “Modeling the Performance of Image Restoration from Motion Blur” at Tampere University of Technology, Tampere, Finland, June 2011.
- “Change Detection Tests Using the ICI Rule” at Tampere University of Technology, Tampere, Finland, June 2010.
- “Image processing case study for Cuda : LPA-ICI Denoising” at Joint Research Center, Ispra, Italy 27th October 2009.
- “Camera-shake image deblurring: modeling and analysis of the restoration performance” at Tampere University of Technology, Tampere, Finland, February 2009.

Student Supervision

PhD Student Supervision

- *Andrea Schillaci* (2018 - 2020), interdisciplinary grant titled “*Computational Fluid Dynamics and Machine Learning for Diagnosing Complex Systems*”, sponsored by Polimi in conjunction with DAER.
- *Diego Carrera* (2015 - 2018), grant titled “*Intelligent embedded systems for high-dimensional and high-complexity datastreams*”, sponsored by STMicroelectronics.

Visiting PhD Student Supervision

- *Adrià Soldevila Coma* (2016 - 2017), PhD student from Universitat Politècnica de Catalunya, research on leak detection in water distribution networks.
- *Andrea Dal Pozzolo* (2014 - 2015), PhD student from ULB, research on fraud detection [JR.3].

Post-Graduate Student Supervision

- *Filippo Leveni* (2019 - 2020), research on anomaly detection in web access to online banking services and e-commerce.
- *Diego Carrera* (2014 - 2015), research on anomaly detection in images, [IC.12], [IC.13].

Master Degree Thesis Advisor

- *Edoardo Gazzaniga* (2019), MSc thesis.
- *Andrea Guglielmetti* (2019), MSc thesis.
- *Semsi Yigit Ozgumus* (2019), MSc thesis.
- *Federico Sandrelli* (2019), MSc thesis.
- *Lorenzo Norcini* (2019), MSc thesis.
- *Andrea Carminati* (2019), MSc thesis.
- *Matteo Guidi* (2019), MSc thesis.
- *Mahsa Sedghi* (2019), MSc thesis.
- *Robreto di Bella* (2019), MSc thesis and research stage c/o STMicroelectronics, Agrate, Italy.
- *Pietro Morbidelli* (2019), MSc thesis and research stage c/o STMicroelectronics, Agrate, Italy.
- *Wentai Zhang* (2019), MSc thesis.
- *Luca Frittoli* (2018), research stage c/o STMicroelectronics, Agrate, Italy.
- *Dilana Cinar* (2018), MSc thesis
- *Filippo Leveni* (2018), MSc thesis
- *Yinan Zhou* (2018), MSc thesis
- *Lidia Moioli* (April 2018), MSc thesis and research stage c/o STMicroelectronics, Agrate, Italy.
- *Andrea Bertarini* (2017), MSc thesis titled “*Monitoring HD progression via dictionary learning on cortical surfaces*” .
- *Marco Longoni* (2017), MSc thesis titled on wearable devices for online ECG monitoring, and research stage c/o STMicroelectronics, Agrate, Italy.
- *Adriano Gaibotti* (2014), MSc thesis titled “*Tampering Detection in Low-Power Smart Cameras*” MSc thesis and research stage c/o STMicroelectronics, Agrate, Italy.
- *Paolo Moretti* (2013), “*Detecting Nonstationarities in Image Sequences*”.

Teaching Activities

Here is the list of courses I have been teaching as a Professor.

2018-2019

Learning Sparse Representations for Image and Signal Modeling (*Professor*) - Information Engineering - PhD.

Informatica A (*Professor*) - Mathematical Engineering - Undergraduate.

Informatica (*Professor*) - Civil Engineering for Risk Mitigation (LC) - Undergraduate.

Image Analysis and Computer Vision (*Teaching assistant*) - Computer Science Engineering - Undergraduate.

2017-2018

Image Classification: Modern Approaches (*Professor*) - Information Engineering - PhD.

Informatica B (*Professor*) - Mechanical and Energy Engineering - Undergraduate.

Informatica (ICA) (*Professor*) - Civil and Environmental Engineering (LC) - Undergraduate.

Image Analysis and Computer Vision (*Teaching assistant*) - Computer Science Engineering - Undergraduate.

2016-2017

Learning Sparse Representations for Image and Signal Modeling (*Professor*) - Information Engineering - PhD.

Learning Sparse Representations for Image and Signal Modeling (*Visiting Professor*) Tampere University of Technology, Faculty of Computing and Electrical Engineering, PhD.

Informatica B (*Professor*) - Mechanical and Energy Engineering - Undergraduate.

Informatica (ICA) (*Professor*) - Civil and Environmental Engineering (LC) - Undergraduate.

Image Analysis and Computer Vision (*Teaching assistant*) - Computer Science Engineering - Undergraduate.

2015-2016

Informatica B (*Professor*) - Mechanical and Energy Engineering - Undergraduate.

Informatica (ICA) (*Professor*) - Civil and Environmental Engineering (LC) - Undergraduate.

Image Analysis (*Teaching assistant*) - Computer Science Engineering - Undergraduate.

Informatica A (*Lab. supervisor*) - Industrial Production Engineering (LC) - Undergraduate.

2014-2015

Informatica B (*Professor*) - Mechanical and Energy Engineering - Undergraduate.

Informatica (ICA) (*Teaching assistant*) - Civil and Environmental Engineering (LC) - Undergraduate.

Image Analysis (*Teaching assistant*) - Computer Science Engineering - Undergraduate.

Informatica A (*Lab. supervisor*) - Industrial Production Engineering (LC) - Undergraduate.

2013-2014

Informatica B (*Professor*) - Mechanical and Energy Engineering - Undergraduate.

Informatica (ICA) (*Teaching assistant*) - Civil and Environmental Engineering (LC) - Undergraduate.

Image Analysis (*Teaching assistant*) - Computer Science Engineering - Undergraduate.

Informatica A (*Lab. supervisor*) - Industrial Production Engineering (LC) - Undergraduate.

2012-2013

Informatica B (*Professor*) - Mechanical and Energy Engineering - Undergraduate.

Informatica A (*Lab. supervisor*) - Industrial Production Engineering (LC) - Undergraduate.

2011-2012

Informatica B (*Teaching assistant*) - Mechanical and Energy Engineering - Undergraduate.

Informatica (ICA) (*Teaching assistant*) - Civil and Environmental Engineering (LC) - Undergraduate.
Image Analysis and Synthesis (*Teaching assistant*) - Computer Science Engineering - Undergraduate.
Computer Vision (*Teaching assistant*) - Computer Science Engineering (CO) - Undergraduate.
Informatica A (*Lab. supervisor*) - Management and Production Engineering - Undergraduate.
Informatica A (*Lab. supervisor*) - Industrial Production Engineering (LC) - Undergraduate.

2010-2011

Informatica B (*Teaching assistant*) - Mechanical and Energy Engineering - Undergraduate.
Informatica (ICA) (*Teaching assistant*) - Civil and Environmental Engineering (LC) - Undergraduate.
Image Analysis and Synthesis (*Teaching assistant*) - Computer Science Engineering - Undergraduate.
Computer Vision (*Teaching assistant*) - Computer Engineering (CO) - Undergraduate.
Informatica A (*Lab. supervisor*) - Management and Production Engineering - Undergraduate.
Informatica A (*Lab. supervisor*) - Industrial Production Engineering (LC) - Undergraduate.
Control Centre Management: Data Transmission, Analysis and Design for Intelligent Alerting Systems (*Teaching assistant*) - Management and Production Engineering (LC) - Undergraduate.

2009-2010

Informatica B (*Teaching assistant*) - Mechanical and Energy Engineering - Undergraduate.
Informatica (ICA) (*Teaching assistant*) - Civil and Environmental Engineering (LC) - Undergraduate.
Image Analysis and Synthesis (*Teaching assistant*) - Computer Science Engineering - Undergraduate.
Computer Vision (*Teaching assistant*) - Computer Science Engineering (CO) - Undergraduate.
Informatica A (*Lab. supervisor*) - Industrial Production Engineering (LC) - Undergraduate.
Informatica A (*Lab. supervisor*) - Management and Production Engineering - Undergraduate.

2008-2009

Informatica B (*Teaching assistant*) - Mechanical and Energy Engineering - Undergraduate.
Informatica (ICA) (*Teaching assistant*) - Civil and Environmental Engineering (LC) - Undergraduate.
Laboratorio di Analisi delle Informazioni e dei Processi Aziendali (*Teaching assistant*) - Management and Production Engineering - Undergraduate.
Image Analysis and Synthesis (*Teaching assistant*) - Computer Science Engineering - Undergraduate.
Computer Vision (*Teaching assistant*) - Computer Science Engineering (CO) - Undergraduate.
Informatica A (*Lab. supervisor*) - Industrial Production Engineering (LC) - Undergraduate.

2007-2008

Laboratorio di Analisi delle Informazioni e dei Processi Aziendali (*Teaching assistant*) - Management and Production Engineering - Undergraduate.
Image Analysis and Synthesis (*Teaching assistant*) - Computer Science Engineering - Undergraduate.
Computer Vision (*Teaching assistant*) - Computer Science Engineering (CO) - Undergraduate.
Informatica A (*Lab. supervisor*) - Industrial Production Engineering (LC) - Undergraduate.

2006-2007

Image Analysis and Synthesis (*Teaching assistant*) - Computer Science Engineering - Undergraduate.
Informatica B (*Lab. tutor*) - Environmental Engineering - Undergraduate.

2005-2006

Image Analysis and Synthesis (*Teaching assistant*) - Computer Science Engineering - Undergraduate.

Complete list of publications

PUBLICATION LIST

Refereed international journals _____	18
Refereed international books and book chapters _____	4
Refereed international conferences _____	39
Editorial contributions _____	1
Workshops _____	7
Patents Proposals _____	2

BIBLIOMETRY

ACADEMIC AGE: 12 years.

FROM GOOGLE SCHOLAR (QUERY DATE: 2019-03-07)

- Citations (all): 1076; h-index: 18; i10-index: 33
- Citations (since 2014): 836; h-index: 16; i10-index: 26

FROM SCOPUS (QUERY DATE: 2019-03-07)

- Documents: 67
- Citations: 711
- h-index: 14

FIVE SELECTED PUBLICATIONS

These are the 5 selected publications that better present my main research activities: [JR.1], [JR.7], [JR.11], [JR.13], [JR.14],

REFEREED INTERNATIONAL JOURNALS

- JR.1. Diego Carrera, Beatrice Rossi, Pasqualina Fragneto, Giacomo Boracchi, "Online Anomaly Detection for Long-Term ECG Monitoring using Wearable Devices" *Pattern Recognition*, Elsevier, In press. [doi: <https://doi.org/10.1016/j.patcog.2018.11.019>]
- JR.2. Diego Carrera, and Giacomo Boracchi "Generating High-Dimensional Datastreams for Change Detection" *Big Data Research* (March 2018), Volume 11, Pages 11-21. [doi: <https://doi.org/10.1016/j.bdr.2017.09.001>]
- JR.3. Andrea Dal Pozzolo, Giacomo Boracchi, Olivier Caelen, Cesare Alippi, and Gianluca Bontempi "Credit Card Fraud Detection: a Realistic Modeling and a Novel Learning Strategy" *IEEE Transactions on Neural Networks and Learning Systems*, August 2018, Volume: 29, Issue: 8 (2018), pp 3784 - 3797. ISSN: 2162-237X. [doi: <https://doi.org/10.1109/TNNLS.2017.2736643>]
- JR.4. Diego Carrera, Giacomo Boracchi, Alessandro Foi, Brendt Wohlberg "Sparse Denoising: Aggregation Versus Global Optimization" *IEEE Signal Processing Letters*, October 2017, Volume: 24, Issue: 10, 1468 - 1472 (2017), ISSN: 1070-9908 [doi: <https://doi.org/10.1109/LSP.2017.2734119>]
- JR.5. Diego Carrera, Fabio Manganini, Giacomo Boracchi, Ettore Lanzarone "Defect Detection in SEM Images of Nanofibrous Materials" *IEEE Transactions on Industrial Informatics*, April 2017, Volume 13, Issu 2, (2017), pp 551 - 561, ISSN: 1551-3203. [doi: <https://doi.org/10.1109/TII.2016.2641472>]
- JR.6. Cesare Alippi, Giacomo Boracchi, Manuel Roveri "Hierarchical Change-Detection Tests," *IEEE Transactions on Neural Networks and Learning Systems*, February 2017, Volume 28, Issue 2 (2017), pp 246 - 258, ISSN: 2162-237X.
- JR.7. Alessandro Foi, Giacomo Boracchi "Foveated Nonlocal Self-Similarity," *International Journal on Computer Vision, Springer* October 2016, Volume 120, Issue 1 (2016), pp 78 - 110, ISSN: 0920-5691. [doi: <http://dx.doi.org/10.1007/s11263-016-0898-1>]
- JR.8. Giacomo Boracchi, Michalis Michaelides, Manuel Roveri "A Cognitive Monitoring System for Detecting and Isolating Contaminants and Faults in Intelligent Buildings," *IEEE Transactions on Systems, Man and Cybernetics: Systems* (2016), 16 pages, accepted, ISSN: 2168-2216. [doi: <http://dx.doi.org/10.1109/TNNLS.2015.2512714>]

- JR.9. Cesare Alippi, Maurizio Bocca, Giacomo Boracchi, Neal Patwari, Manuel Roveri “RTI Goes Wild: Radio Tomographic Imaging for Outdoor People Detection and Localization,” *IEEE Transactions on Mobile Computing*, October 2016, Volume 15, Issue 10, (2016), pp 1536 - 1233,, ISSN: 1536-1233.
[doi: <http://dx.doi.org/10.1109/TMC.2015.2504965>]
- JR.10. Cesare Alippi, Giacomo Boracchi and Manuel Roveri “A reprogrammable and intelligent monitoring system for rock-collapse forecasting“ *IEEE Systems Journal* June 2016, Volume 10, Issue 10, pp 733-744 (2016), ISSN: 1932-8184.
[doi: <http://dx.doi.org/10.1109/JSYST.2015.2429913>]
- JR.11. Cesare Alippi, Giacomo Boracchi and Manuel Roveri “Just In Time Classifiers for Recurrent Concepts“ *IEEE Transactions on Neural Networks and Learning Systems*, April 2013, Volume 24, Issue 4 (2013), pp. 620 - 634, (ISSN: 2162-237X).
Outstanding Paper Award IEEE TNLS 2016 [AW.1].
[doi: <http://dx.doi.org/10.1109/TNLS.2013.2239309>]
- JR.12. Cesare Alippi, Giacomo Boracchi and Manuel Roveri “Ensembles of Change-Point Methods to Estimate the Change Point in Residual Sequences“ *Soft Computing, Springer*, November 2013, Volume 17, Issue 11, pp. 1971-1981 (2013), pp. 1971-1981, (ISSN: 1432-7643).
[doi: <http://dx.doi.org/10.1007/s00500-013-1130-7>]
- JR.13. Matteo Maggioni, Giacomo Boracchi, Alessandro Foi and Karen Egiazarian, “Video Denoising, Deblocking and Enhancement Through Separable 4-D Nonlocal Spatiotemporal Transforms “ *IEEE Transactions on Image Processing*, September 2012, Volume 21, Issue 9, (2012), pp 3952 - 3966, (ISSN: 1057-7149).
[doi: <http://dx.doi.org/10.1109/TIP.2012.2199324>]
- JR.14. Giacomo Boracchi and Alessandro Foi, “Modeling the Performance of Image Restoration from Motion Blur “ *IEEE Transactions on Image Processing*, August 2012, Volume 21, Issue 8 (2012), pp. 3502- 3517, (ISSN: 1057-7149).
[doi: <http://dx.doi.org/10.1109/TIP.2012.2192126>]
- JR.15. Cesare Alippi, Giacomo Boracchi and Manuel Roveri “A just-in-time adaptive classification system based on the intersection of confidence intervals rule,” *Neural Networks, Elsevier*, October 2011, Volume 24, Issue 8 (2011), pp.791 - 800 (ISSN: 0893 - 6080).
[doi: <http://dx.doi.org/10.1016/j.neunet.2011.05.012>]
- JR.16. Giacomo Boracchi, Alessandro Foi “Uniform motion blur in Poissonian noise: blur/noise trade-off,” *IEEE Transactions on Image Processing* February 2011, volume 20, Issue 2 (2011), pp.592 - 598, (ISSN: 1057 - 7149).
[doi: <http://dx.doi.org/10.1109/TIP.2010.2062196>]
- JR.17. Cesare Alippi, Giacomo Boracchi, Romolo Camplani, Manuel Roveri, “Detecting External Disturbances on Camera Lens in Wireless Multimedia Sensor Networks,” *IEEE Transactions on Instrumentation and Measurement*, November 2010, Volume 59, Issue 11 (2010), pp. 2982 - 2990, (ISSN: 0018 - 9456).
[doi: <http://dx.doi.org/10.1109/TIM.2010.2047129>]
- JR.18. Giacomo Boracchi, “Estimating the 3D Direction of a Translating Camera From a Single Motion-Blurred Image,” *Pattern Recognition Letters, Elsevier*, February 2009, Volume 30, Issue 7, (2009), pp. 671 - 681 (ISSN: 0167-8655).
[doi: <http://dx.doi.org/10.1016/j.patrec.2009.02.002>]

REFEREED CHAPTERS IN INTERNATIONAL BOOKS

- IB.1. Cesare Alippi, Giacomo Boracchi, Greg Ditzler, Robi Polikar, Manuel Roveri, “Adaptive Classifiers for Nonstationary Environments,” *Contemporary Issues in Systems Science and Engineering, IEEE/Wiley Press Book Series, 2015*
- IB.2. Cesare Alippi, Giacomo Boracchi, Li Bu, and Dongbin Zhao “Encoding-Decoding Machines for Online Concept-Drift Detection on Datastreams,” in *Frontiers of Intelligent Control and Information Processing, pp. 263-282, Oct 2014 World Scientific Publishing (Singapore)*, (ISBN: 978-981-4616-87-4)
[doi: http://dx.doi.org/10.1142/9789814616881_0010]
- IB.3. Cesare Alippi, Giacomo Boracchi, Romolo Camplani, Manuel Roveri, “Wireless Sensor Networks for Monitoring Vineyards,” in *Methodologies and Technologies for Networked Enterprises, (G. Anastasi, E. Bellini, E. Di Nitto, C. Ghezzi, L. Tanca, E. Zimeo, Editors), Lecture Notes in Computer Science, 7200, pp 295 - 310, July 2012. Springer.* (ISBN: 978-3-642-31738-5).
[doi: http://dx.doi.org/10.1007/978-3-642-31739-2_15]
- IB.4. Giacomo Boracchi, Vincenzo Caglioti, Alessandro Giusti, “Estimation of 3D Instantaneous Motion of a Ball from a Single Motion-Blurred Image,” in *Computer Vision and Computer Graphics. Theory and Applications. Communications in Computer and Information Science, Springer Berlin Heidelberg*, pp. 225-237, (2009) (ISBN: 978-3-642-10226-4).
[doi: <http://dx.doi.org/10.1007/978-3-642-10226-4>]

REFEREED INTERNATIONAL CONFERENCES

- IC.1. Giacomo Boracchi, Diego Carrera, Cristiano Cervellera and Danilo Macciò, “QuantTree: Histograms for Change Detection in Multivariate Data Streams”, *International Conference on Machine Learning (ICML)* 2018, Stockholm, Sweden, 8 pages.
- IC.2. Marco Longoni, Diego Carrera, Beatrice Rossi, Pasqualina Fragneto, Marco Pessione, Giacomo Boracchi, “A Wearable Device for Online and Long-Term ECG Monitoring”, *International Joint Conference on Artificial Intelligence (IJCAI)* - Demo Track, 3 pages
- IC.3. Diego Carrera, Beatrice Rossi, Pasqualina Fragneto, and Giacomo Boracchi “Domain Adaptation for Online ECG Monitoring”, *Proceedings of IEEE International Conference on Data Mining, IEEE ICDM 2017*, New Orleans, Louisiana, USA, 6 pages.
- IC.4. Giacomo Boracchi, Cristiano Cervellera and Danilo Macciò, “Uniform Histograms for Change Detection in Multivariate Data”, *Proceedings of International Joint Conference on Neural Networks, IJCNN 2017*, Anchorage, Alaska, USA, 6 pages.
- IC.5. Cesare Alippi, Giacomo Boracchi and Diego Carrera “CCM: Controlling the Change Magnitude in High Dimensional Data”, *Proceedings of 2nd INNS Conference on Big Data*, October 23-25, 2016, Thessaloniki, Greece, 10 pages Best Regular Paper Award [AW.2].
- IC.6. Diego Carrera, Beatrice Rossi, Daniele Zambon, Pasqualina Fragneto, and Giacomo Boracchi “ECG Monitoring in Wearable Devices by Sparse Models”, *Proceedings of European Conference on Machine Learning and Principles and Practice of Knowledge Discovery, ECML-PKDD 2016*, Riva del Garda, Italy, September, 19-23, 16 pages
- IC.7. Cesare Alippi, Giacomo Boracchi, Diego Carrera and Manuel Roveri “Change Detection in Multivariate Datastreams: Likelihood and Detectability Loss”, *Proceedings of International Joint Conference of Artificial Intelligence, IJCAI 2016*, New York, USA, July, 9-13, 7 pages
- IC.8. Diego Carrera, Giacomo Boracchi, Alessandro Foi and Brendt Wohlberg “Scale-invariant Anomaly Detection With Multiscale Group-sparse Models”, *Proceedings of IEEE International Conference on Image Processing, ICIP 2016*, Phoenix, AZ, USA, September 25-28, 5 pages
- IC.9. Giacomo Boracchi, Michalis Michaelides, Manuel Roveri, “Detecting contaminants in smart buildings by exploiting temporal and spatial correlation” *Proceedings of , Intelligence for Embedded and Cyberphysical Systems at SSCI 2015, IEEE Symposium Series on Computational Intelligence, Cape Town, South Africa, December 9 - 12*,
[doi: <http://dx.doi.org/10.1109/SSCI.2015.94>]
- IC.10. Adriano Gaibotti, Claudio Marchisio, Alexandro Sentinelli, and Giacomo Boracchi “Tampering Detection In Low-Power Smart Cameras”, *Proceedings of Engineering Applications of Neural Networks EANN 2015*, Island of Rhodes , Greece, September 25 - 28,
[doi: http://dx.doi.org/10.1007/978-3-319-23983-5_23]
- IC.11. Andrea Dal Pozzolo, Giacomo Boracchi, Olivier Caelen, Cesare Alippi and Gianluca Bontempi “Credit Card Fraud Detection and Concept-Drift Adaptation with Delayed Supervised Information”, *Proceedings of IEEE-INNS International Joint Conference on Neural Networks IJCNN 2015*, Killarney, Ireland, July 12 - 17,
[doi: <http://dx.doi.org/10.1109/IJCNN.2015.7280527>]
- IC.12. Diego Carrera, Giacomo Boracchi, Alessandro Foi, Brendt Wohlberg “Detecting Anomalous Structures by Convolutional Sparse Models ” *Proceedings of IEEE-INNS International Joint Conference on Neural Networks, IJCNN 2015*, Killarney, Ireland, July 12 - 17,
[doi: <http://dx.doi.org/10.1109/IJCNN.2015.7280790>]
- IC.13. Giacomo Boracchi, Diego Carrera, Brendt Wohlberg “Novelty Detection in Images by Sparse Representations” *Proceedings of Intelligent Embedded Systems at SSCI 2014, IEEE Symposium Series on Computational Intelligence*, Orlando, Florida, December 9 - 12,
[doi: <http://dx.doi.org/10.1109/INTELES.2014.7008985>]
- IC.14. Cesare Alippi, Giacomo Boracchi, Brendt Wohlberg, “Change Detection in Streams of Signals with Sparse Representations” *Proceedings of IEEE International Conference on Acoustics, Speech and Signal Processing, ICASSP 2014*, Florence, Italy, May 4 - 9, pp. 5252 - 5256
[doi: <http://dx.doi.org/10.1109/ICASSP.2014.6854605>]
- IC.15. Giacomo Boracchi, Manuel Roveri, “Exploiting Self-Similarity for Change Detection” *Proceedings of IEEE-INNS International Joint Conference on Neural Networks, IJCNN 2014*, Beijing, China July 6 - 11 2014, pp. 3339 - 3346
[doi: <http://dx.doi.org/10.1109/IJCNN.2014.6889860>]
- IC.16. Giacomo Boracchi, Michalis Michaelides, Manuel Roveri, “A Cognitive Monitoring System for Contaminant Detection in Intelligent Buildings” *Proceedings of IEEE-INNS International Joint Conference on Neural Networks, IJCNN 2014*, Beijing, China July 6 - 11 2014, pp. 69 - 76
[doi: <http://dx.doi.org/10.1109/IJCNN.2014.6889452>]

- IC.17. Giacomo Boracchi, Manuel Roveri, "A Reconfigurable and Element-wise ICI-based Change-Detection Test for Streaming Data" Proceedings of *Computational Intelligence and Virtual Environments for Measurements Systems and Applications, CIVEMSA 2014*, Ottawa, Canada, May 5-7 2014, pp. 58 - 63
[doi: <http://dx.doi.org/10.1109/CIVEMSA.2014.6841439>]
- IC.18. Cesare Alippi, Giacomo Boracchi, Vicenç Puig, Manuel Roveri, "An Ensemble Approach to Estimate the Fault-Time Instant," Proceedings of *International Conference on Intelligent Control and Information Processing, ICICIP 2013*, pp 836-841 (ISBN: 978-1-4673-6248-1).
[doi: <http://dx.doi.org/10.1109/ICICIP.2013.6568188>]
- IC.19. Alessandro Foi and Giacomo Boracchi, "Anisotropically Foveated Nonlocal Image Denoising," Proceedings of *IEEE International Conference on Image Processing, ICIP 2013*.
[doi: <http://dx.doi.org/10.1109/ICIP.2013.6738096>]
- IC.20. Cesare Alippi, Giacomo Boracchi, Manuel Roveri, "Just-In-Time Ensemble of Classifiers," Proceedings of *IEEE-INNS International Joint Conference on Neural Networks IJCNN 2012*, pp 1-8 (ISBN: 978-1-4673-1488-6).
[doi: <http://dx.doi.org/10.1109/IJCNN.2012.6252540>]
- IC.21. Cesare Alippi, Giacomo Boracchi, Manuel Roveri, "On-line Reconstruction of Missing Data in Sensor/Actuator Networks by Exploiting Temporal and Spatial Redundancy," Proceedings of *IEEE-INNS International Joint Conference on Neural Networks IJCNN 2012*, pp. 1-8 (ISBN: 978-1-4673-1488-6).
[doi: <http://dx.doi.org/10.1109/IJCNN.2012.6252689>]
- IC.22. Alessandro Foi, Giacomo Boracchi "Foveated self-similarity in nonlocal image filtering," Proceedings of *of IS&T / SPIE Electronic Imaging 2012, HVEI (2012)*, pp. 1-12. (ISBN: 978-0-8194-8938-8).
[doi: <http://dx.doi.org/10.1117/12.912217>]
- IC.23. Federico Maggi, Alberto Volpatto, Simone Gasparini, Giacomo Boracchi, Stefano Zanero, "A Fast Eavesdropping Attack Against Touchscreens," Proceedings of *IEEE IAS 2011 (2011)*, pp. 320 - 325 (ISBN: 978-1-4577-2154-0).
[doi: <http://dx.doi.org/10.1109/ISIAS.2011.6122840>]
- IC.24. Cesare Alippi, Giacomo Boracchi, Manuel Roveri, "A distributed Self-adaptive Nonparametric Change-Detection Test for Sensor/Actuator Networks," Proceedings of *Artificial Neural Networks and Machine Learning, ICANN 2011, Lecture Notes in Computer Science, Springer Berlin / Heidelberg (2011)*, vol. 6792/2011, pp. 173-180 (ISBN: 978-3-642-21737-1).
[doi: http://dx.doi.org/10.1007/978-3-642-21738-8_23]
- IC.25. Federico Maggi, Alberto Volpatto, Simone Gasparini, Giacomo Boracchi, Stefano Zanero, "POSTER: Fast, Automatic iPhone Shoulder Surfing" Proceedings of *ACM CCS 2011 (2011)*, pp. 1-3 (ISBN: 978-1-4503-0948-6).
- IC.26. Cesare Alippi, Giacomo Boracchi, Antonio Marullo, Manuel Roveri, "A Step Towards the Prediction of a Rock Collapse: Analysis of Micro-Acoustic Bursts," Proceedings of *IEEE Sensors 2011 (2011)*, pp. 1273 - 1276 (ISBN: 978-1-4244-9290-9).
- IC.27. Cesare Alippi, Giacomo Boracchi, Manuel Roveri, "A Hierarchical, Nonparametric Sequential Change-Detection Test," Proceedings of *IEEE-INNS International Joint Conference on Neural Networks IJCNN 2011*, pp. 2889 - 2896 (ISBN: 978-1-4244-9635-8).
[doi: <http://dx.doi.org/10.1109/IJCNN.2011.6033600>]
- IC.28. Cesare Alippi, Giacomo Boracchi, Manuel Roveri, "An Effective Just-in-Time Adaptive Classifier for Gradual Concept Drifts," Proceedings of *IEEE-INNS International Joint Conference on Neural Networks IJCNN 2011*, pp. 1675 - 1682 (ISBN: 978-1-4244-9635-8).
[doi: <http://dx.doi.org/10.1109/IJCNN.2011.6033426>]
- IC.29. Matteo Maggioni, Giacomo Boracchi, Alessandro Foi, Karen Egiazarian, "Video denoising using separable 4D nonlocal spatiotemporal transforms," Proceedings of *SPIE Image Processing: Algorithms and Systems VI (2011)*, pp. 1 - 11 (ISBN: 978-0-8194-8407-9).
[doi: <http://dx.doi.org/10.1117/12.872569>]
- IC.30. Cesare Alippi, Giacomo Boracchi, Manuel Roveri, "Adaptive Classifiers with ICI-based Adaptive Knowledge Base Management," Proceedings of *Artificial Neural Networks and Machine Learning Lecture Notes in Computer Science, ICANN 2010, Springer Berlin / Heidelberg (2010)*, vol. 6353/2010, pp. 458-467, (ISBN: 978-3-642-15821-6).
[doi: http://dx.doi.org/10.1007/978-3-642-15822-3_56]
- IC.31. Cesare Alippi, Giacomo Boracchi, Manuel Roveri, "Change Detection Tests Using the ICI rule," Proceedings of *IEEE-INNS International Joint Conference on Neural Networks IJCNN 2010*, pp. 1-7 (ISBN: 978-1-4244-6916-1).
[doi: <http://dx.doi.org/10.1109/IJCNN.2010.5596537>]

- IC.32. Cesare Alippi, Giacomo Boracchi, Manuel Roveri, “Just in time classifiers: Managing the slow drift case,” Proceedings of *IEEE-INNS International Joint Conference on Neural Networks IJCNN 2009*, pp. 114 - 120 (ISBN: 978-1-4244-3548-7).
[doi: <http://dx.doi.org/10.1109/IJCNN.2009.5178799>]
- IC.33. Giacomo Boracchi, Alessandro Foi, Vladimir Katkovnik, Karen Egiazarian “Deblurring Noisy Radial-Blurred Images: a spatially adaptive filtering approach,” Proceedings of *SPIE Image Processing: Algorithms and Systems VI* (2008), 12 pages. (ISBN: 978-0-8194-6984-7)
[doi: <http://dx.doi.org/10.1117/12.769400>]
- IC.34. Giacomo Boracchi, Vincenzo Caglioti, Alberto Danese “Estimating Camera Rotation Parameters From a Blurred Image,” Proceedings of *International Conference on Computer Vision Theory and Applications, VISAPP 2008*, pp. 389 - 395. (ISBN 978-989-8111-21-0)
- IC.35. Giacomo Boracchi, Vincenzo Caglioti, Alessandro Giusti “Single-Image 3D Reconstruction of Ball Velocity and Spin From Motion Blur - An Experiment in Motion-from-Blur,” Proceedings of *International Conference on Computer Vision Theory and Applications, VISAPP 2008*, pp. 22 - 29. (ISBN 978-989-8111-21-0)
- IC.36. Giacomo Boracchi, Vincenzo Caglioti, “Corner Displacement from Motion Blur,” IEEE Proceedings of *International Conference on Image Analysis and Processing, ICIAP 2007*, pp 589 - 594 (ISBN: 978-0-7695-2877-9). [doi: <http://dx.doi.org/10.1109/ICIAP.2007.4362841>]
- IC.37. Giacomo Boracchi, Vincenzo Caglioti, Alessandro Giusti “Ball Position and Motion Reconstruction from Blur in a Single Perspective Image,” IEEE Proceedings of *IEEE International Conference on Image Analysis and Processing, ICIAP 2007*, pp 87 -92 (ISBN: 978-0-7695-2877-9).
[doi: <http://dx.doi.org/10.1109/ICIAP.2007.4362762>]
- IC.38. Giacomo Boracchi, Vincenzo Caglioti, “Motion Blur Estimation At Corners,” Proceedings of *International Conference on Computer Vision Theory and Applications, VISAPP 2007*, pp. 296-302 (ISBN 978-972-8865-73-3).
- IC.39. Vincenzo Caglioti, Pierluigi Taddei, Giacomo Boracchi, Simone Gasparini, Alessandro Giusti, “Single Image Calibration of Off-Axis Catadioptric Cameras Using Line” Proceedings of *IEEE 11th International Conference on Computer Vision, ICCV 2007* 6 pages (ISBN: 978-1-4244-1631-8).
[doi: <http://dx.doi.org/10.1109/ICCV.2007.4409192>]

EDITORIAL CONTRIBUTIONS

- EP.1. Cesare Alippi, Giacomo Boracchi, Brendt Wohlberg “Model Complexity, Regularization and Sparsity” Guest Editorial in *IEEE Computational Intelligence Magazine* November 2016 issue.

REFEREED INTERNATIONAL WORKSHOPS

- WS.1. Diego Carrera, Giacomo Boracchi, Alessandro Foi, Brendt Wohlberg “Sparse Denoising: Aggregation Versus Global Optimization” *Proc. of SPARS 2017, Workshop on Signal Processing with Adaptive Sparse Structured Representations*. (2017).
- WS.2. Diego Carrera, Giacomo Boracchi, Alessandro Foi, Brendt Wohlberg “Anomaly Detection Using Convolutional Sparse Models” *Proc. of SPARS 2015, Workshop on Signal Processing with Adaptive Sparse Structured Representations*. (2015).
- WS.3. Alessandro Foi, Giacomo Boracchi, “Nonlocal Foveated Principal Components,” *Proc. 2014 IEEE Workshop on Statistical Signal Processing, SSP 2014*, Gold Coast, Australia, June 29 2014-July 2 2014, pp. 145 - 148.
[doi: <http://dx.doi.org/10.1109/SSP.2014.6884596>]
- WS.4. Giacomo Boracchi, Vicenç Puig, Manuel Roveri, “A Hierarchy of Change-Point Methods for Estimating the Time Instant of Subtle Leakages in Water Distribution Networks,” *Proc. of LEAPS 2013, the 1st Workshop on Learning strategies and data processing in nonstationary environments* (2013), pp. 615-624 (ISBN: 978-3-642-41141-0).
- WS.5. Alessandro Foi, Giacomo Boracchi, “Anisotropic Foveated Self-Similarity,” *Proc. of SPARS 2013, Workshop on Signal Processing with Adaptive Sparse Structured Representations*. (2013).
- WS.6. Cesare Alippi, Giacomo Boracchi, Manuel Roveri, “Detecting Drops on Lens in Wireless Multimedia Sensor Network Nodes,” *Proc. of ROSE 2009, IEEE International Workshop on Robotic and Sensors Environments* (2009), pp. 128-133 (ISBN: 978-1-4244-4777-0).
- WS.7. Giacomo Boracchi, Alessandro Foi “Multiframe Raw-Data Denoising Based On Block-Matching And 3-D Filtering For Low-Light Imaging And Stabilization,” *Proc. of LNLA 2008, the International Workshop on Local and Non-Local Approximation in Image Processing* (2008), 8 pages.

PATENTS

- PT.1. L. Moioli, P. Fragneto, B. Rossi, D. Carrera, G. Boracchi, M. Fumagalli, E. Tagliabue, P. Giugni “Revealing machine footprint in defective wafers without hand-crafted feature extraction” US Patent Application [] 2018-10-29
- PT.2. B. Rossi, P. Fragneto, D. Zambon, D. Carrera, G. Boracchi “Method for the Detecting Electrocardiogram Anomalies and Correspondng System” US Patent Application [US15169184] 2016-05-31

SUBMITTED TO REFEREED INTERNATIONAL JOURNALS AND PREPRINTS

- TR.1. D. Carrera, G. Boracchi, D. Maccio, C. Cervellera “Ensemble of Histograms for Change Detection”, under review.
- TR.2. R. Di Bella, D. Carrera, B. Rossi, P. Fragneto, G. Boracchi “Wafer Defect Map Classification Using Sparse Convolutional Networks”, under review.

Consapevole delle sanzioni penali, nel caso di dichiarazioni non veritiere, di formazione o uso atti falsi richiamate dallart. 763 del D.P.R. 445 del 28 dicembre 2000, nonch della sanzione ulteriore prevista dallart. 754 del citato D.P.R. 445 del 28 dicembre 2000, consistente nella decadenza dai benefici eventualmente conseguenti al provvedimento emanato sulla base della dichiarazione non veritiera, dichiaro che le informazioni riportate nel presente curriculum vitae sono veritiere.

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