

**University of Padova,
Dept. of Information Engineering**

**2018 Summer School of Information
Engineering**

**Cyber Physical Systems:
Sensors, Signal Processing and
Applications**



**Casa della Gioventù, via Rio Bianco, 39042 Bressanone (BZ), Italy
July 23 – 27, 2018**

the co-Directors

Prof. Gaudenzio Meneghesso, gauss@dei.unipd.it

Prof. Michele Rossi, rossi@dei.unipd.it

Message from the organizers

*This edition of SSIE is dedicated to the memory of Prof. **Silvano Pupolin**, an esteemed colleague and a friend. Silvano founded this summer school in 1991, and has been his Director until 2016. He passed away on February 11, 2018. He always loved organizing this school and, above all, spending time with the students, nurturing a great research community. Initial editions offered a training program on telecommunications engineering, with lessons spanning over three days. Since then, the school has grown, attracting students from abroad, becoming a place where European projects and International collaborations could find a home for discussion, seminars, training activities and so forth.*

Technically, SSIE 2018 is revolved around **cyber physical systems**, targeting:

- I. **sensing technology**: lessons and seminars will be given on the design of nano biosensors, and ultra low power receivers for IoT devices
- II. **signal processing techniques**: analysis of sequential data, deep learning for visual data
- III. **applied signal processing & applications**: *gait analysis* through multiple sensors, portable devices for *augmented reality*, human-in-the-loop: sensing and actuation for *autonomous driving* scenarios

The teachers are leading experts in their respective fields; we are honored to have them aboard and we do thank them for their kind support. We are truly proud of this year's program.

We hope you will enjoy the school, Brixen, and take a bit of time to immerse yourself in the fresh air, exciting trails and stunning views of the surrounding alps.

The organizers,

Gaudenzio Meneghesso

Michele Rossi

University of Padova, Dept. of Information Engineering
2018 Summer School of Information Engineering

Cyber Physical Systems: Sensors, Signal Processing and Applications

Monday 23/7 (Casa della Gioventù)

8:45 – 9:00 **Gaudenzio Meneghesso, Michele Rossi** *Department of Information Engineering, University of Padova*: “Summer School introduction, program description”

9:00 – 11:00 **Arben Merkoçi**, *Catalan Institute of Nanoscience and Nanotechnology (ICN2)*, “Nanobiosensors designs and applications in health diagnostics, environment monitoring, safety and security”

11:00 – 13:00 **Alessandro De Toni, Giulio Rosati**, *Department of Information Engineering, University of Padova*, “Biosensors and their applications”

Tuesday 24/7 (Casa della Gioventù)

9:00 – 11:00 **Michele Rossi**, *Department of Information Engineering, University of Padova* “Learning for Sequential Data: Tools and Applications”

11:00 – 13:00 **Yao-Hong Liu**, *IMEC, Belgium*, “Ultra-low power RF receiver design for the IoT”

14:30 – 15:30 **Giovanni Breglio**, *University of Naples, Federico II*, “FBG Fiber Optic Sensors: from Theory to Application”

Wednesday 25/7 (Casa della Gioventù / (*) Grüner Baum Hotel)

9:00 – 11:00 **Alessandro Beghi, Mattia Bruschetta**, *Department of Information Engineering, University of Padova*; “Sensing and actuating for Human-in-the-Loop systems: the autonomous driving case”

11:00 – 13:00 **Lamberto Ballan**, *Department of Mathematics, University of Padova*; “Visual Recognition in the Deep Learning Era”

19:30 – 22:00 **Social Dinner**

Thursday 26/7 (Casa della Gioventù)

9:00 – 11:00 **Marco Tartagni**, *Department of Electrical, Electronic, and Information Engineering University of Bologna*; “Sensor design: investigation on a general framework optimization rules”

11:00 – 13:00 **Aldo Romani**, *Department of Electrical, Electronic, and Information Engineering, University of Bologna*; “An introduction to energy harvesting and micro-power management”

14:20 – 14:30 **Calogero Oddo**, “Italy Chapter of the IEEE Sensors Council: objectives and opportunities for students”

14:30 – 16:30 **Student presentations**

Friday 27/7 (Casa della Gioventù)

9:00 – 11:00 **Zimi Sawacha**, *Department of Information Engineering, University of Padova*; “Quantitative Gait Analysis: Techniques and their Challenges”

11:00 – 13:00 **Simone Milani**, *Department of Information Engineering, University of Padova*; “When Virtual Meets Real: Recent Advances in Augmented Reality Portable Devices”

Abstracts & Bios

Arben Merkoçi, *Catalan Institute of Nanoscience and Nanotechnology (ICN2)*,

Title: "Nanobiosensors designs and applications in health diagnostics, environment monitoring, safety and security"

Abstract: In this lecture I will give first an overview on diagnostics field, the need for point of care devices and the importance of biosensors. In this context, I will talk about the high demand to develop innovative and cost effective devices with interest for health care beside environment diagnostics, safety and security applications. The development of such devices is strongly related to new materials and technologies being nanomaterials and nanotechnology of special role. I will show how we use new nanomaterials such as nanoparticles, graphene nano/micromotors and integrate these in simple sensors thanks to their advantageous properties. Beside plastic platforms physical, chemical and mechanical properties of cellulose in both micro and nanofiber-based networks combined with their abundance in nature or easy to prepare and control procedures are making these materials of great interest while looking for cost-efficient and green alternatives for device production technologies. Both paper and nanopaper-based biosensors are emerging as a new class of devices with the objective to fulfil the "World Health Organization" requisites to be ASSURED: affordable, sensitive, specific, user-friendly, rapid and robust, equipment free and deliverable to end-users. How to design simple paper-based biosensor architectures? How to tune their analytical performance upon demand? How one can couple nanomaterials such as metallic nanoparticles, quantum dots and even graphene with paper and what is the benefit? How we can make these devices more robust, sensitive and with multiplexing capabilities? Can we bring these low cost and efficient devices to places with low resources, extreme conditions or even at our homes? Which are the perspectives to link these simple platforms and detection technologies with mobile communication? I will try to give responses to these questions through various interesting applications related to protein, DNA and even contaminants detection all of extreme importance for diagnostics, environment control, safety and security."

Arben Merkoçi is currently ICREA Professor and director of the Nanobioelectronics & Biosensors Group at Institut Català de Nanociència i Nanotecnologia (ICN2). After his PhD (1991) at Tirana University (Albania), in the topic of Ion-Selective-Electrodes (ISEs) Dr. Merkoçi worked as postdoc and senior researcher/invited professor in the field of nanobiosensors and lab-on-a-chip technologies in Italy, Spain, USA and since 2006 at ICN2. Prof. Merkoçi research is focused on the design and application of cutting edge nanotechnology and nanoscience based cost/efficient biosensors. The paper/plastic-based nanobiosensors involve integration of biological molecules (DNA, antibodies, cells and enzymes) and other (bio)receptors with micro- and nanostructures/motors and applied in diagnostics, environmental monitoring or safety and security. He has published around 270 peer review research papers, supervised around 25 PhD students and has been invited to give plenary lectures and keynote speeches in around 100 occasions in various countries. He is co-founder of two spin-off companies, PaperDrop dedicated to nanodiagnostics and GraphenicaLab to electronic printing. See more at: <http://www.nanobiosensors.org/group-leader/>.

Giulio Rosati, Department of Information Engineering (DEI), University of Padova, Italy

Alessandro De Toni, ARC – Applied Research Center, Padova, Italy

Title: "Biosensors and their applications"

Abstract: Biosensors are one of the most attracting topics in recent years. Biosensors can detect and measure substances and molecules of interest in a wide variety of applications, such as metabolites in the blood, pollutants in water or in the air, and contaminants in our food. This makes biosensors a strongly interdisciplinary field of research, which requires electronic, biological, medical, and chemical competencies. In this seminar, we will explore the main characteristics of biosensors and we will investigate some relevant case studies of biosensors we currently use every day. Then, we will explore what is appearing in the research scenario and potential applications.

Giulio Rosati received the Master degree in Bioengineering in 2011 and the PhD in Biotechnology in 2015 at the University of Padova, working on electrochemical biosensor for the detection of small molecules and organic compounds. He is now a young post-doc at the Department of Information Engineering of the University of Padova. His main interest is the development and characterization of

low-cost electrochemical and optical sensors and biosensors in the agri-food, clinical, and sport sectors. Within these activities he has participated to several national and international conferences, publishing in high impact interdisciplinary journals, and collaborating with many companies, spin-offs, and research institutions. Since 2015, Giulio is directly involved in the organization of the Biosensors course for the Master degree last of Bioengineering and Electronic engineering of the University of Padova.

Michele Rossi, *Department of Information Engineering, University of Padova*

Title: "Learning for Sequential Data: Tools and Applications"

Abstract: in this seminar, I will first review some learning architectures for the analysis of sequential data. Particular emphasis will be paid to Hidden Markov models and Recurrent Neural Networks. I will go first through some basic theory, to explain why and how theoretical models can be used in practical settings and the implications about their training with real data. Hence, a small set of selected applications from the Cyber Physical System domain will be expounded, and suitable processing pipelines will be proposed based on the material presented in the first part.

Michele Rossi is Associate Professor at the Department of Information Engineering (DEI), University of Padova (UNIPD), Italy. His research interests are centered around a) stochastic modeling, optimization and protocol design for Wireless Sensor Networks (WSN) and Internet of Things (IoT), with focus on wearable IoT devices and smart health, b) optimization of mobile networks in the presence of renewable energy sources and c) optimization of market, control and telecommunication aspects of Smart Energy Grids. He have authored more than 100 scientific papers published in International conferences, book chapters and Journals, mainly of the IEEE, two patents (with DOCOMO) and he have been the recipient of four best paper awards from the IEEE. Since 2005, he has actively supervised the research activity on Internet of Things (IoT) within the Signet group @ DEI. In 2005–2009, Dr. Rossi has collaborated with the Ubiquitous Networking Research group @ DOCOMO Euro-Labs (Munich, Germany) in the design of distributed processing, storage and data dissemination for ad hoc networks (Network Coding and Compressive Sensing). Since 2010, he has been working with Worldsensing (Barcelona, Spain) on optimized WSN solutions for Smart Cities and environmental monitoring, this collaboration led to joint publications and continues nowadays through the involvement in the H2020 MSCA SCAVENGE ITN. Since 2002, he has been involved in numerous EU projects on WSN/IoT such as EYES (protocols for energy efficient WSN, 2002–2005), e-SENSE (protocols and architectures for WSN, 2004–2007), SENSEI (WSN as enablers of the future Internet, 2007-2010) and SWAP (Marie Curie, Symbiotic Wireless Autonomous Powered systems, 2010–2014). In 2010-2013, he has been the technical coordinator of the protocol design activity (WP3) within the EU IOT-A project (the flagship FP7 EU project on Internet of Things Architectures, 2010–2013) and a senior Marie Curie researcher within SWAP. Since 2010, he has been the Principal Investigator of six research projects, including MOSAIC ("MONitoring Sensor and Actuator networks through Integrated Compressive Sensing and data gathering", 2010–2012), a SAMSUNG GRO award on biometric signal processing for wearable IoT devices (2014–2015), the H2020 MSCA ITN SCAVENGE on mobile networks exploiting ambient energy (2016–2019) and the IoT-SURF project on software libraries and processing tools for connected and unconnected IoT objects (2016–2017). From 2011 to 2016 he has been Associate Editor of the IEEE Transactions on Wireless Communications. Since January 2016, he is Associate Editor of the IEEE Transactions on Mobile Computing. He has been on the TPC of 100+ international conferences and regularly serves as reviewer for scientific Journals of the IEEE, ACM, Springer and Elsevier. He is a Senior Member of the IEEE.

Yao-Hong Liu, *imec*

Title: "Ultra-low power RF receiver design for IoT"

Abstract: Bluetooth Low-Energy (BLE) is currently the most popular short-range wireless protocol for Internet of Things (IoT). One of the most challenging design requirements for BLE RF transceiver is to consume as low as possible power consumption, while fulfilling the PHY specifications. In this tutorial, the BLE design specifications will be briefly introduced. Then, several low-power transceiver

architectures that are suitable for BLE will be discussed. Finally, an overview of recent state-of-the-art BLE transceivers will be provided

Yao-Hong Liu (S'04-M'09-SM'17) received his Ph.D. degree from National Taiwan University, Taiwan, in 2009. Since 2010, he joined imec, the Netherlands. His current position is Principal Membership of Technical Staff, and he is leading the development of the ultra-low power (ULP) RFIC design. His research focuses are energy-efficient digital-intensive RF transceivers and radar for IoT. He currently serves as a technical program committee of IEEE ISSCC and RFIC symposium.

Giovanni Breglio: *University of Naples, Federico II*
Title: "FBG Fiber Optic Sensors: from Theory to Application"

Abstract: In this lecture we will review the essential topics of the theoretical description and the main applications of sensors based on the use of Bragg gratings written in optical fibers for telecommunications: FBG sensors systems. For more than 30 years, since the discovery of the Bragg effect and its application to optical fibers, the use and development of integrated sensors in optical fibers has experienced an exponential improvement and numerical expansion. Mainly in the field of Structural Health Monitoring, but not only, this type of fiber optic sensor is now present in many fields of applications. We will start from the theoretical description of the basic principles of light-guided propagation in optical fibers, we will deal with the theoretical definition of the reflection spectrum of a Bragg grating in optical fiber, we will show the dependence of the spectral response of these types of objects, we will describe the opto-electronic systems useful for the 'reading' of these sensors, and finally we will analyze (from a system point of view) different practical applications and their characteristics/performances in terms of metrological parameters.

Giovanni Breglio graduated in Electronic Engineering cum laude in 1990 and received the PhD in Electronic Engineering and Computer Science from University of Naples in 1994. He is Full Professor of Electronics at Federico II University. His research interests include the Electro-Thermal modeling and characterization of Semiconductor Devices, the design of Optoelectronic devices and the development of new Fiber Optical sensors. He has authored more than 65 peer-reviewed journal papers and more than 125 proceedings of international conferences (with a SCOPUS h-index of 20, Numbers of Citations 1307; RG Score of 35,18, h-index 21, Numbers of Citations 1370). In 2005 and 2006 he was member of the Scientific Technical Committee of IEEE SENSORS. In 2006 he was member of the organizing committee of the International Symposium on Power Semiconductor Devices (ISPSD) 2006. In 2007 he was member of the Local Organizing Committee of European Workshop on Optical Fibre Sensors 2007. In 2008 he was member of the Scientific Committee of the First Mediterranean Photonics Conference. In 2008 he was local chair and publication chair of IEEE SENSORS 2008. From 2012 he is in the TCP of ESREF conference. From 2017 he is in the TCP of ISPSD IEEE conference.

Alessandro Beghi, Mattia Bruschetta, *Department of Information Engineering, University of Padova*
Title: "Sensing and actuating for Human-in-the-Loop systems: the autonomous driving case"

Abstract: in recent years, OEM's investment in the development of autonomous vehicles/ADAS systems favored a huge improvement in the challenging task of sensing complex environments, and safely operating the vehicle within them. However, sensors engineering and fusion is just one of aspect of the entire problem, as it is crucial to analyze in depth all of the aspects that concern the interaction of humans with robotized systems. In this respect, human monitoring is key to make the human-robot co-existence possible. As far as the associated control problem is concerned, the present-day trend is that of considering the human involvement in system operation in the so-called Human-in-the-Loop (HIL) perspective, to effectively tackle the high level of coordination between automated systems and humans. An effective and widespread tool that represents a superb testbed to analyze the Human-Machine Interaction (HMI) typical of autonomous driving scenarios in a reproducible, safe environment is the dynamic driving simulator, which is, in turn, a complex HIL application. In this context the main challenges to be addressed and that will be discussed in this seminar are: (i) Definition of the role of the human in the task, (ii) How to increase the situation

awareness of the operator, (iii) Coping with the unpredictable signals or decisions from the human user, (iv) How to ensure feasibility of the overall control task.

Alessandro Beghi received the Laurea degree cum laude in Electrical Engineering in 1989 and the Ph.D. degree in Control Systems Engineering in 1993, both from the University of Padova, Italy. In 1994 he joined the Department of Information Engineering, University of Padova, Italy, where he is currently a Professor of Control Systems Engineering. He held visiting positions at universities and international research centers both in Europe and in the USA. His research interests include modelling and control, filtering and identification, model reduction, fault detection and isolation, and their applications. He has worked on a wide range of control applications, from control of fusion devices, guidance algorithms for virtual vehicles, to control of HVAC&R systems, Adaptive Optics systems, and semiconductor manufacturing processes. He has been responsible of research projects funded by the European Union, the Italian Ministry for Instruction and Research, the University of Padova, and of research activities with national and international industrial partners. He is co-inventor of 6 Patents on the use of advanced control techniques in different applications fields. He is the author of more than 180 publications in journals, books, and conference proceedings.

Mattia Bruschetta received the M.S. degree (cum laude) in control system engineering and the Ph.D. degree in information engineering both from the University of Padova, working on Mechanical system identification, in 2007 and 2011, respectively. He is currently a Senior Research Fellow with the Department of Information Engineering (DEI) leading a project for the development of an NMPC-based motion cueing algorithms for high performance professional dynamic platforms. His research interests include fast nonlinear model predictive control, human-machine interaction control problems, automotive, virtual prototyping, motion cueing, virtual driver/rider, system identification, and numerical integration.

Lamberto Ballan, *Department of Mathematics, University of Padova*

Title: "Visual Recognition in the Deep Learning Era"

Abstract: A key goal of computer vision is to understand complex visual scenes, by recognizing visual concepts, localizing them, and understanding their interactions within the scene. In this lecture, I will give an overview of recent advancements in visual recognition thanks to deep learning methods such as convolutional-neural networks and recurrent neural networks. However, in trying to build such models, we need powerful visual learning techniques in order to be able to capture the rich diversity of the visual world. But this requires large training sets collected with manual supervision, such as ImageNet, and it is not always possible to harvest such datasets. Therefore, in the second part of the talk, I will discuss how to learn effective representation for visual perception without full supervision.

Lamberto Ballan is an assistant professor (tenure track) of computer science at University of Padova, Italy. Previously, he was a senior postdoctoral researcher at Stanford University and University of Florence, Italy, supported by a prestigious Marie Curie Fellowship from the European Commission. He received the Laurea and Ph.D. degrees in computer engineering in 2006 and 2011, both from the University of Florence, and was also a visiting scholar at the Signal and Image Processing department at Telecom Paristech, France, in 2010. His primary research area is computer vision, closely integrated with applied machine learning and multimedia, specifically focused on exploiting big data for visual recognition problems. Dr. Ballan has published more than 40 papers in the most prestigious journals and conferences in computer vision, pattern recognition, multimedia and image processing. His papers have been cited approx. 1700 times (H-index 20) and he received the best paper award at the ACM Workshop on Social Media 2010. He is the lead organizer of the Web-scale Vision and Social Media workshops (CVPR/ICCV/ECCV 2012-17) and he gave tutorials at several premier conferences (including ICPR'12, ACM-MM'15, CVPR'16).

Marco Tartagni, *Dep. of Electrical, Electronic, and Information Engineering University of Bologna*

Title: "Sensor design: investigation on a general framework optimization rules"

Abstract: Sensor analysis and design is often reduced to a taxonomy of technology and applications. However, the sensor designer real issues are always the same in any context: will we be able to achieve the goal and what are the degrees of freedom to work with? Even if this is in general a hard problem, a uniform framework could better enlight the issue. In this lecture I will introduce a general vision and characterization of electronic sensing from the information theory viewpoint. I will also

introduce a general approach to analyze and optimize transduction chains in order to understand detection limits and trade-offs using examples.

Marco Tartagni received an M.S. in Electrical Engineering in 1988 and a Ph.D. in Electrical Engineering and Computer Sciences in 1993 both from the University of Bologna, Italy. During his Ph.D. program, he joined the Department of Electrical Engineering at the California Institute of Technology, Pasadena, CA in 1992 as a visiting student and in 1994 as a research fellow, working on various aspects of analog VLSI for image processing. Since March 1995 he has been with the Department of Electronics, Bologna University, where he is currently an Associate Professor. From 1996 to 2001 he was team leader in the joint STMicroelectronics and Bologna University lab working on intelligent sensors such as CMOS cameras and biometric devices. In 1997, within that framework, he was the designer of the first silicon-only fingerprint capacitive sensor. In 1999 he was co-founder of Silicon Biosystems, and in 2001 he was a co-founder of the Center of Excellence for Electronic Design ARCES, University of Bologna. He was co-recipient of the Van Vessel Outstanding Paper Award, received at the 2004 IEEE ISSCC conference, for presenting a biosensor platform based on dielectrophoresis. From 2005 to 2008 he was European coordinator of FP6 RECEPTRONICS in the Nanotechnology thematic area. Since 2008 he has been coordinator of the Energy Autonomous Systems and member of the More-than-Moore roadmapping team within the European CATRENE initiatives. He is author or co-author of more than 100 peer-reviewed scientific publications in the field of sensor theory, design and testing. He is also the holder of 18 US granted patents and 11 European and WIPO patents. .

Aldo Romani, *Department of Electrical, Electronic, and Information Engineering University of Bologna*

Title: "An introduction to energy harvesting and micro-power management"

Abstract: A special care has to be devoted to the design of power conversion and management circuits for energy harvesting applications where, in many practical cases, the available power is often as low as few μW . This talk will review a series of design techniques for different types of sources that ensure ultra-low intrinsic consumptions and pursue effective trade-offs with conversion efficiency. The performance trends will be analyzed. Practical cases based on both integrated and off-the-shelf electronics will be discussed.

Aldo Romani has been an Associate Professor of Electronics at the University of Bologna, Campus of Cesena, since 2015. His main field of research involves electronic circuits and systems, with a special focus on integrated architectures. His research interests include micro-/nano-power and ultra-low voltage circuits for energy harvesting applications, modeling and fabrication of micro-magnetics, wireless sensor networks for smart metering and energy efficiency, the design of integrated interfaces for CMOS Hall sensors, and applications of piezoelectric transducers. In 2008 he was appointed Assistant Professor of Electronics at the Second School of Engineering at the Campus of Cesena of the University of Bologna, where, since 2015, he has been Associate Professor of Electronics. He participated to several national and European research programmes among which: ECSEL CONNECT as coordinator of the IUNET consortium (1.366 M€ estimated costs) and of the UNIBO research unit (718 k€ estimated costs), H2020 ENABLES as coordinator of the UNIBO research unit (250 k€ estimated costs), ENIAC E2SG as coordinator of the UNIBO research unit (600 k€ estimated costs), FLAG-ERA CONVERGENCE, ECSEL R2POWER300, ENIAC LAB4MEMS, PRIN 2011 GRETA "GREEn TAGs and sensors with ultrawideband identification and localization capabilities", FP7 Guardian Angels for a Smarter Life (FET Flagship Pilot Project), ENIAC END, FP7 Nanofunction, FP5 MeDICS as researcher. He is a reviewer for several scientific journal, among which IEEE Transactions on Power Electronics, IET Power Electronics, Sensors and Actuators A: Physical, IEEE Transactions on Circuits and Systems, IEEE Journal of Solid-State Circuits, IEEE Transactions on Industrial Electronics, IEEE Journal on Emerging and Selected Topics in Circuits and Systems, IEEE Sensors. He is author or co-authors of more than 70 scientific publications on journals and international conferences.

Zimi Sawacha, *Department of Information Engineering, University of Padova*

Title: "Quantitative Gait Analysis: Techniques and their Challenges"

Abstract: Human movement analysis aims to obtain quantitative information about the biomechanics and motor control of movement during the execution of motor tasks of varying levels of complexity. In particular, data can be obtained on movement kinematics and kinetics, muscle activity during

movement and the temporal and spatial parameters of the footstep pattern (Cappozzo et al., 2005). Joints kinematics are often obtained using stereophotogrammetry (motion capture) or inertial sensors. Joints kinetics are measured using dynamometers and force plates. The electrical activity of muscles is recorded through electromyography and metabolic energy can be assessed using methods such as indirect calorimetry. In this context gait analysis is recognized as a useful assessment tool in the field of human movement research, aiming at providing instrumented measurement and evaluation of walking ability in patients with impairments specific to locomotion (Benedetti et al 2017). A standard procedure must consider the following aspects: 1) reconstruction of skeletal movement during gait, 2) estimation of inertial parameters of body segments, 3) measurement of external forces, 4) timing and amplitude of muscle recruitment, 5) use of metrics for the description of gait mechanics (i.e., the conventions for the representation of the articular kinematics and dynamics), 6) gait temporal and spatial parameters (Benedetti et al 2017).

Zimi Sawacha earned a Master Degree in Mechanical Engineering (2000- project and development of a strain gage force platform) and a PhD in Biomedical Engineering (2007) at the University of Padova, with a thesis on bioengineering applied to diabetic foot prevention. In 2001, she worked as research fellow at Helen Hayes Hospital CRT (New York, USA) under the supervision of Mary Wotten and Stephen Sprigle, working on the NIH grant, "Optimizing Posture, Trunk Control and Reach of Wheelchair Users". She then did one year as research fellow at Istituto Ortopedico Rizzoli (Bologna) in order to develop a new protocol for children's gait analysis. She has been with the School of Bioengineering, University of Padova (2007- up to now). She has been research investigator in national and international projects: the European Project "Myheart", 6° Program (2004-2006); PRIN 2007 "Mobility assessment, age and physical activity related mobility variations assessment of adults through ambulatory and daily living monitoring" (2007-2009), Progetto di Ateneo "Diabetic foot prevention through biomechanics analysis and custom foot orthotics"(2009-2011), Progetto di Ateneo "Development of a multi-physics diabetic foot model for plantar ulcers prevention in diabetic subjects" (2014-2016). She is reviewer for several international journals. She has been teaching classes of Bioengineering of Movement, in the Master degree of Biomedical Engineering, and in the Master and Bachelor degrees of Kinesiology at the University of Padova (Italy), from 2004 up to now. She is member of the Italian Society of MOtion Analysis in Clinic (SIAMOC), she is member of the Consensus Conference on Clinical Gait Analysis promoted by the same society, and she is the Conference's President of the same society for the 2015 edition in Padova (Siamoc 2015). Her scientific production includes more than 100 publications published in peer-reviewed journals and international conference proceedings. Her research activity, in cooperation with national and international scientific institutions, mainly concerns the human movement analysis and biomechanics, orthopaedics and sports science applications. She takes part as a co-author of a patent for industrial invention (2017 - Metodo ed apparato per rilevare parametri biomeccanici e funzionali del ginocchio).

Simone Milani, *Department of Information Engineering, University of Padova*

Title: "When Virtual Meets Real: Recent Advances in Augmented Reality Portable Devices"

Abstract: The last years have witnessed a widespread growing of Augmented Reality (AR) applications in different ICT fields, ranging from entertainment and industrial design to health care. Such diffusion has been fostered by the availability of wearable AR devices, which integrates effective 3D acquisition sensors with engaging displays and highly-accurate classification algorithms. These have enabled a seamless integration of both virtual and real objects allowing the user to interact with them in a natural way and access a huge set of additional information. As a matter of fact, many augmented reality systems have been recently addressed as "mixed" reality systems. The talk is going to present some of the latest technologies employed in AR portable and wearable devices. In detail, the focus will be on 1) modeling the surrounding reality and understanding user position; 2) enabling an accurate Human-Computer interaction via gesture and voice interfaces; 3) providing a reliable visual and aural feedback to the user. Then the presentation will deal with the problem of integrating all these solutions and optimizing them for a specific application. In the end, the talk will overview some emerging applications in medical and industrial fields where the adoption of wearable AR technology has brought some significant breakthroughs.

Simone Milani received his Laurea Degree (5 years course) from the University of Padova, Italy, on December 2002. On March 2007 he received a Ph.D. title in Electronic and Telecommunications Engineering by the same institution. From January 2007 until April 2014, he was Post-Doc researcher at the University of Padova and at Politecnico di Milano. Since May 2014 he has been Assistant

Professor at the Department of Information Engineering of the University of Padova, teaching “Source Coding”, “Computer vision and 3D Graphics”, “3D Augmented Reality”. His main research topics are digital signal processing, image and video compression, 3D acquisition and coding, virtual and augmented reality applications. He is also active in the fields of multimedia forensics and security. He is also a IEEE member of Information Theory and Signal Processing Societies and he has also been a reviewer for many international magazines and conferences. He has also served as international scientific expert for the Agence Nationale de la Recherche (ANR). Since 2018, he is member of the IEEE SPS Regional Committee (Region 8).

General information

All relevant info can be found at: <http://www.dei.unipd.it/ssie>

Lessons will be at the: “Casa della Gioventù”, via Rio Bianco, 39042 Bressanone, Italia

ECTS credits

PhD students will be awarded **5 ECTS credits**. For that, they will have to deliver a technical report on some of the school's topics, which will be evaluated by the Organizers. The report may include a throughout state of the art on some of the presented theories/technologies and/or elaborating upon them, through additional discussions, extensions, simulations, etc.

How to submit a proposal

Submission of proposals from participants is highly appreciated and, in fact, encouraged. Title and abstract of a talk can be specified using the registration form at the link:

<http://ssie.dei.unipd.it/whenwhereaccomodationregistration/>

The deadline for submitting proposals is June 30th 2018.

Presenting your research activity

Each presenter will be assigned a slot of **20 minutes**, including 5 minutes for questions. All presentations will be in English.

Registration & Fee

There is no fee for attending the School, but participants will have to pay for their travel and living expenses. All the participants are invited to Register through the Website:

<http://ssie.dei.unipd.it/whenwhereaccomodationregistration/>

The deadline for registering is June 30th 2018.

Accommodation: we have an agreement with **Grüner Baum Hotels** (www.gruenerbaum.it) in Bressanone (Brixen), which will provide lodging at very unbeatable discount prices (**July 22th - July 27th only**), see also the SSIE Website for details: <http://ssie.dei.unipd.it/>

Net prices	
single room	75.00 Euro per person per day (breakfast included)
double room	58.00 Euro per person per day (breakfast included)
double room (single use)	100.00 Euro per person per day (breakfast included)
half pension supplement	18.00 Euro per person per day
meal	9,50 Euro for a first course

Taxes: Euro 2,30 per person/night. Included in the price:

- Breakfast Grande buffet, entrance to swimming pool, the BRIXENCARD

Reservation: by phone (+39 0472 274 100), fax (+39 0472 274 101) or email (info@gruenerbaum.it) with reference to: **summer school “Prof. Pupolin”**. Either a credit card number or a deposit of 60,00 euros per room will be required.