

29th Summer PhD School of Information Engineering SSIE 2019

jointly organized by
DEI - University of Padova
IEEE - Italy Section

Artificial Intelligence & Machine Learning for ICT Applications



Casa della Gioventù, via Rio Bianco, 39042 Bressanone (BZ), Italy
July 8 – 12, 2019

the school director

Prof. Michele Rossi (DEI, UNIPD)

the school co-directors

Prof. Gaudenzio Meneghesso (DEI, UNIPD)

Prof. Tiziana Tambosso (Past-Chair, IEEE Italy Section)

Prof. Bernardo Tellini (Chair, IEEE Italy Section)

Message from the organizers

The 29th edition of SSIE will be centered on Artificial Intelligence (AI) and Machine Learning (ML) techniques for ICT applications. SSIE 2019 is co-organized by the **Department of Information Engineering (DEI)** of the University of Padova and by the **IEEE Italy Section**.

The following IEEE Chapters were involved in the organization of the event:

- Computational Intelligence Chapter (CI)
- Engineering in Medicine and Biology Chapter (EMB)
- Sensors Council Chapter (SENS)
- Communications Chapter (COM)
- Computer Chapter (COMP)

The school program develops around the following topics:

- **AI/ML theory (CI)**: advanced seminars on cutting edge AI/ML theory: “Deep Learning on Graphs” and “Explainable Artificial Intelligence”;
- **biomedical applications (EMB, SENS)**: ML for motion analysis, musculoskeletal modelling and simulation, biometric systems and encoding/decoding neuromorphic sensor data;
- **telecommunication networks (COM)**: ML approaches towards new physical channel and networking designs. New cutting edge & cross-disciplinary applications: the “Tactile Internet”;
- **cyber-security (COMP)**: cloud computing and access regulation.

The school features three distinguished speeches and a half-day student workshop, where PhD students will have their opportunity to present their technical work. A best presentation award will be presented by the IEEE Sensors Chapter.

All 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,



Michele Rossi



**Gaudenzio
Meneghesso**



Tiziana Tambosso



Bernardo Tellini

SSIE 2019: Artificial Intelligence & Machine Learning for ICT Applications

All lessons will be given at the **Casa della Gioventù**, via Rio Bianco, 39042 Bressanone (BZ), Italy

Monday 8/7

CI

- 8:30 - 8:45** **Michele Rossi**, DEI@UNIPD, "School Opening"
- 8:45 - 10:45** **Nicolò Navarin**, Department of Mathematics, University of Padova, *Kernel methods and Deep Learning on Graphs*
- 11:00 - 13:00** **Corrado Mencar**, Department of Informatics, University of Bari, *Explainable Artificial Intelligence*

Tuesday 9/7

EMB/SENS

- 8:30 - 10:30** **Distinguished lecture. Josep Maria Font Llagunes**, Biomechanical Engineering Lab., UPC, Barcelona, *Personalized robotic exoskeleton design for assisted walking using musculoskeletal modelling and simulation*
- 10:45 - 12:45** **Calogero Maria Oddo**, BioRobotics Institute, Scuola Superiore Sant'Anna (SSSA), Pisa, *Encoding and decoding of neuromorphic sensor data by means of bioinspired machine learning methods*
- 14:00 - 16:00** **Fabio Scotti**, Dept. of Informatics, University of Milan, *Artificial Intelligence for Biometric Systems and Applications*

Wednesday 10/7

SENS/COM

- 8:30 - 10:30** **Eduardo Palermo**, Dept. of Mechanical and Aerospace Eng., La Sapienza, *A Machine Learning approach for analyzing human motion activities using data from wearable sensors*
- 10:45 - 12:45** **Distinguished lecture. Frank H. P. Fitzek**, TU Dresden, *The Tactile Internet revolution: democratizing skills and expertise*
- 14:00 - 16:00** **Stavros Ntalampiras**, Dept. of Computer Science, University of Milan, *Machine learning for audio signal processing*
- 19:30 - 22:00** **Social dinner**

Thursday 11/7

COM

- 8:00 - 10:00** **Luca Sanguinetti**, Dept. of Information Eng., University of Pisa, *Deep Learning Power Control in Massive MIMO*
- 10:15 - 13:15** **Distinguished lecture. Marco di Renzo**, Signals & Systems Lab., Paris-Saclay University, *Wireless Networks Design in the Era of Deep Learning: Model-Based, AI-Based, or Both?*

Friday 12/7

COMP

- 8:30 - 10:30** **Giovanni Livraga**, Dept. of Informatics, University of Milan, *Data Security and Privacy in Emerging Scenarios*
- 10:45 - 12:45** **Alessandro Armando**, DIBris Dept., University of Genova, *Securing Distributed Applications: introduction to Cryptographic Protocols*
- 14:00 - 16:00** **Fabio Roli**, Dept. of Electrical Eng., University of Cagliari, *Cybersecurity after the Rise of Adversarial Machine Learning*
- 16:00 - 16:20** **Michele Rossi**, *Best Student Presentation Award & Summer School Wrapup*

Abstract & Bios

Prof. Nicolò Navarin (CI)
Department of Mathematics "Tullio-Levi Civita"
University of Padova, Italy

Talk title: "Kernel methods and Deep Learning on Graphs"

Abstract: Graphs are a common and natural way to represent many real world data, e.g. in Chemistry a compound can be represented by its molecular graph, in social networks the relationships between users are represented as edges in a graph where users are nodes and edges represent their relationships. Many computational tasks involving such graphical representations require machine learning, such as the classification of active/non-active drugs for a specific disease, or the prediction of the creation of a future link between two users in a social network. State-of-the-art machine learning techniques for classification and regression on graphs include kernel machines equipped with specifically designed kernels for graphs, and neural networks for graphs. On one hand, graph kernels are based on predefined structural features, i.e, the definition of features is not part of the learning process, that may perform very well if the features are suited for the specific task. On the other hand, the definition of features in neural networks for graphs is based on a learning process. However, defining neural networks for graph data is not an easy task: many works tackle the problem from different viewpoints, but the research field is young and there is plenty of room for improvements. In this seminar, we will go through recent developments in both neural and kernel approaches, understanding their strengths and limitations.

Biosketch: Nicolò Navarin is currently an assistant professor in Computer Science at the Department of Mathematics, University of Padova, Italy. He received his B.Sc. and M.Sc. in computer science from the University of Padova in 2008 and 2010, respectively, and the Ph.D. in computer science from the University of Bologna, Italy, in 2014. In 2013, he was a visiting Researcher at the University of Freiburg, Germany. He has been a research fellow in the Department of Mathematics at the University of Padova, and in the school of Computer Science at the University of Nottingham, UK. His research interests are in the field of machine learning, including kernel methods and neural networks for structured data, and applications to bioinformatics, business process mining, computer vision and computational psychology. He is a member of the IEEE Computational Intelligence Society, IEEE Task Force on Deep learning, International Neural Network Society, and Italian Association for Machine Learning.

Prof. Corrado Mencar (CI)
Computational Intelligence Laboratory
Department of Informatics, University of Bari, Italy

Talk title: "Explainable Artificial Intelligence"

Abstract: In recent years, Artificial Intelligence has been pervading our daily lives and our society by an overwhelming number of technological artifacts that are changing the way we address problems at any level: from organizing a trip to treating fatal diseases. Unsurprisingly, the European Commission recognized AI as one of the most strategic

technologies of our century. But, as all technological revolutions, AI comes with a price and people must decide whether they want to be actually assisted by AI and under which conditions. There are many situations where the introduction of AI technologies cannot be done lightly. For example, who is accountable for an accident caused by an AI-controlled car? Is a sentence partially determined on AI-based decisions the result of a due process? What is the scientific value of an AI system that is capable of predicting a physical phenomenon? These are only few of thorny questions that are stimulating the scientific, political and other institutional communities towards a responsible adoption of AI whenever automated decisions have far-reaching impacts. One of the features that are invoked for AI systems that are taking critical decisions is explainability, i.e. people must understand why a decision has been made, how much trustworthy the system is in the specific context that led to the decision, etc. Explainable Artificial Intelligence (XAI) is an endeavor to evolve AI methodologies and technology by focusing on the development of agents capable of both generating decisions that a human could understand in a given context, and explicitly explaining such decisions. This way, it is possible to verify if automated decisions are made on the basis of accepted rules and principles, so that decisions can be trusted and their impact justified. The talk will give an outlook on XAI, starting from the motivating principles and proceeding with an account of the main concepts. The objective is to understand what is meant by explainability and why it is so important in the realm of information engineering. The main challenges that characterize the design of XAI systems will be briefly presented, and some successful case studies will be outlined. In fact, the design of XAI systems requires a careful re-thinking of all the typical steps needed to develop an intelligent system: humans must be at the center of any design decision. Finally, since XAI research is young and flourishing, some promising research directions will also be summarized.

Biosketch: Corrado Mencar (MSc 2000, PhD 2005) is Assistant Professor at the Department of Informatics, University of Bari "Aldo Moro", Italy. His research interests include Explainable Artificial Intelligence, especially in the field of Computational Intelligence and Granular Computing, with special focus on fuzzy logic systems. In 2011, he introduced the concept of semantic co-intension as a new way to define interpretability in fuzzy systems. He published more than 100 papers in international journals and conferences. Also, he gave tutorials and invited speeches on the subjects of XAI and interpretable fuzzy systems. He was recently appointed as General Chair of the IV European Summer School on Fuzzy Logic and Applications (SFLA 2018) promoted by the European Society on Fuzzy Logic, Applications and Technologies (EUSFLAT) and he regularly organizes scientific events on XAI in international conferences.

Prof. Josep Maria Font Llagunes (EMB)

Biomechanical Engineering Lab.

Universitat Politècnica de Catalunya (UPC), Barcelona, Spain

Talk title: "Personalized robotic exoskeleton design for assisted walking using musculoskeletal modelling and simulation"

Abstract: Walking impairment after spinal cord injury (SCI) is prevalent in society and leads to a decreased quality of life as well as secondary complications (e.g., chronic pain, diabetes, heart disease). Despite the fact that robotic assistance has recently shown to be effective, when combined with manual therapy, for neurorehabilitation and lower limb motor function recovery, current gait-assistive exoskeletons are expensive and complex to operate and thus are rarely used in a clinical setting. We present an innovative affordable,

lightweight and intuitive robotic exoskeleton to assist over-ground walking in individuals with SCI who possess remaining hip function. Personalization of the robotic exoskeleton design is crucial because no two SCI patients are the same, and thus, computer multibody simulation is the perfect tool to personalize the control and design of the exoskeleton to the needs of each patient. This talk will present the conception and design evolution of the [ABLE exoskeleton](#); and will outline how patient-specific predictive simulations, that combine musculoskeletal modelling and optimal control, can help to design better assistive technologies that are personalized to the specific needs of people with neuromuscular impairments.

Biosketch: Josep Maria Font-Llagunes is Associate Professor of the Department of Mechanical Engineering at Universitat Politècnica de Catalunya (UPC), and Co-Founder and CSO of the spin-off ABLE Human Motion. He is also the Director of the Biomechanical Engineering Lab (BIOMECH) of the UPC Research Centre for Biomedical Engineering (CREB). Currently, he is Associate Director of Research and Technology Transfer at the Barcelona School of Industrial Engineering (ETSEIB), having served as Associate Director of Postgraduate Studies during the period 2013-2017. He obtained the Master's Degrees in Mechanical Engineering and Biomedical Engineering from UPC in 2002 and 2004, respectively. Then, he received his PhD Degree in Mechanical Engineering from University of Girona in 2007. After this period, he did his postdoc at the Centre for Intelligent Machines of McGill University (Canada). He founded the BIOMECH Lab in 2009 and, since then, has led several competitive projects and industrial contracts in the areas of rehabilitation robotics, biomechanics of human movement and multibody system dynamics. So far, he has published 34 articles in international journals, more than 100 conference papers, 3 book chapters, and has supervised 3 doctoral theses. He chaired the ECCOMAS Thematic Conference on Multibody Dynamics that took place in Barcelona in 2015, and has actively participated in the program and organizing committees of various scientific conferences. He is Editorial Board Member of the journal Multibody System Dynamics. Currently, he serves as Vice-President of the Spanish Chapter of the European Society of Biomechanics (ESB), and is also member of the Technical Committee for Multibody Dynamics of IFToMM. Josep Maria has been awarded with the Agustín de Betancourt y Molina Medal by the Royal Academy of Engineering (2017), the OpenSim/NCSRR Outstanding Researcher Award (2017), and the Leonardo Grant by the BBVA Foundation (2018).

Prof. Calogero Maria Oddo (SENS)
BioRobotics Institute
Scuola Superiore Sant'Anna (SSSA), Pisa, Italy

Talk Title: "Encoding and decoding of neuromorphic sensor data by means of bioinspired machine learning methods"

Abstract: The talk will discuss the achievements obtained towards the development of artificial touch sensors able to emulate the physiological spike-based encoding of tactile information in humans. This challenge is being addressed, in close collaboration with neuroscientists and clinicians, with the main purpose to partially restore tactile sensory capabilities in upper limb amputees. Furthermore, the developed technologies and computational methods that emulate the neuronal stages of the human somatosensory system can be used in several application scenarios in robotics, medicine and artificial intelligence.

Biosketch: Calogero Maria Oddo (1983) has a Ph.D. in BioRobotics from Scuola Superiore Sant'Anna (SSSA), M.Sc. and B.Sc. in Electronic Engineering from University of Pisa (UNIPi), 1st and 2nd level degrees in Industrial and Information Engineering from SSSA (10 positions, 334 applicants), all with honours. He is currently Tenure-Track Assistant Professor of Bioengineering, he obtained the national scientific habilitation to serve as Associate Professor, and he coordinates the Neuro-Robotic Touch Laboratory (20 research fellows) at The BioRobotics Institute of SSSA. He holds courses on Neuromorphic Engineering for BSc, MSc and PhD students at SSSA and UNIPi. He has over 70 conference and journal publications and a growing track record in integrating biorobotics and neuroscience, with particular interests in the study of the human sense of touch and on its artificial engineering, and in this field he authored high-impact publications. He has a H-index of 20 and a total of 1900+ citations (source: Scholar). His studies were also disseminated in national (Rai, Mediaset, ...) and international media (BBC, Fox News, ...). He has a growing portfolio of successful research grants and he was/is co-PI or WP leader within EU-H2020, EU-FP7 and National projects. In 2016 he served as senior advisor of the FET-Flagships interim evaluation panel appointed by the European Commission and he currently serves as member of the Advisory Board of the EFFECT EU-H2020-FET project and as Vice Chair of the Italy Chapter of the IEEE Sensors Council. He is the recipient of the Working Capital grant with the SensAlone project, funded by Telecom Italia company (30 grants, 2133 applicants). In 2012 he was finalist in the "Georges Giralt PhD Award", the most important European PhD award in robotics, organized by EURON, the "European Robotics research Network", and in 2009 he was finalist for the Best Student Paper Award at the IEEE Conference on Robotics and Biomimetics.

Prof. Fabio Scotti (EMB)
Department of Informatics
University of Milan, Italy

Talk title: "Artificial Intelligence for Biometric Systems and Applications"

Abstract: The course aims at presenting biometric recognition approaches based on recent artificial intelligence techniques. In traditional pattern biometric systems, the designer needs to develop algorithms to extract a set of discriminative features from data. Artificial intelligence and in particular Deep learning approaches learn sets of discriminative features directly from multidimensional signals. The course presents biometric systems from a technological point of view and provides an excursus of recent artificial intelligence approaches, including with specific reference to Neural Networks Convolutional Neural Networks, Autoencoders, and Deep Belief Neural Networks.

Biosketch: Fabio Scotti received the Ph.D. degree in computer engineering from the "Politecnico di Milano", Milan, Italy, in 2003. He has been an Associate Professor in Computer Science with the Università degli Studi di Milano, Crema, Italy, since 2015. His research results have been published in over 100 papers in international journals, proceedings of international conferences, books, book chapters, and patents. His current research interests include biometric systems, machine learning and computational intelligence, signal and image processing, theory and applications of neural networks, three-dimensional reconstruction, industrial applications, intelligent measurement systems, and high-level system design. Dr. Scotti is an Associate Editor of the IEEE Transactions on Human-Machine Systems and Soft Computing (Springer). He has been an Associate Editor

of the IEEE Transactions on Information Forensics and Security, and a Guest Co-editor for the IEEE Transactions on Instrumentation and Measurement.

Prof. Eduardo Palermo (EMB/SENS)
Department of Mechanical and Aerospace Engineering
University of Rome, La Sapienza, Italy

Talk Title: A Machine Learning approach for analyzing human motion activities using data from wearable sensors

Abstract: Tracking and analyzing human motion activities has a tremendous potential in several application fields. Although naked eye observation easily captures motion anomalies or specific features, the automatic technology-aided recognition is often a remarkable challenge. Machine learning algorithms might help in this process, achieving exceptional performance, even without a great scientific insight in the phenomenon. This lecture will briefly introduce machine learning theory in general, and then explore some research solution which leveraged machine learning algorithms in very diverse applications. Gait phase segmentation, for instance, can be particularly telling about gait impairments. A Hidden Markov Model-based solution for “measuring” gait quality, both in children with cerebral palsy and adults with Parkinson’s disease, will be explained. Sports is a further application field that might benefit from inertial wearable sensors coupled with machine learning. In another recent research work, performance of different most-adopted machine learning algorithms (Support Vector Machine, k-Nearest Neighbors, Artificial Neural Networks, and Decision Tree) were compared, in the automatic recognition of the two types of violation during race-walking. An overview on the results would help in understanding applicability of the different typologies of algorithms to the specific problem.

Biosketch: Dr. Eduardo Palermo is Assistant Professor and PhD advisor in the Department of Mechanical and Aerospace Engineering of Sapienza University of Rome. He received his Ph.D. in February 2014 in Industrial Production Engineering at Sapienza University. From June 2014 to June 2015 he had a Postdoc appointment at New York University Tandon School of Engineering. He currently teaches Biomechanics and Mechanical and Thermal Measurement courses. Dr. Palermo's research interest is the design, implementation, and validation of new technologies in Experimental Biomechanics and Robotics for Rehabilitation, with focus on human gait and motion analysis. His research activity involved wearable inertial sensors, machine learning algorithms, mechatronics, human-computer interactions, motor control, bio-signal processing. The studies he conducted included in-vivo clinical experimentation in cooperation with clinical research partners.

Prof. Frank Fitzek (COM)
Chair Head of the “Deutsche Telekom Chair of Communication Networks”
TU Dresden, Germany

Talk title: “The Tactile Internet revolution: democratizing skills and expertise”

Abstract: The tactile Internet paradigm aims at enhancing collaborations between humans and machines or, more generally, cyber-physical systems (CPS) in real, virtual, and remote environments. The objective is to enable humans to interact with co-operating CPS over intelligent wide-area-communication networks to promote equitable access to remote work

and learning environments for people of different genders, ages, cultural backgrounds, or physical limitations. Thus, going far beyond the current state of the art, democratising the access to skills and expertise the same way as the current Internet has democratised the access to information. The talk will cover cutting edge research initiatives that are currently undertaken by CeTI (<https://www.ceti.one/>), which conducts multidisciplinary research to (i) advance the understanding of the complexities and dynamics of human goal-directed perceptions and actions from the psychological and medical perspectives, (ii) develop novel sensor and actuator technologies that augment the human mind and body, (iii) develop fast, bendable, adaptive, and reconfigurable electronics, (iv) create intelligent communication networks that connect humans and CPS by continuously adapting and learning to provide low latency, as well as high levels of resilience and security, (v) design new haptic coding schemes to cope with the deluge of information from massive numbers of body sensors, (vi) design online learning mechanisms as well as interface solutions for machines and humans to predict and augment each other's actions, and (vii) to evaluate the above solutions as well as to engage the general public about the societal and ethical changes and new opportunities the new technologies will bring by means of use cases in medicine (context-aware robotic assistance systems in medical environments), industry (co-working industrial space), and the Internet of Skills (education and skill acquisition for the general public).

Biosketch: Frank H. P. Fitzek is a Professor and head of the “Deutsche Telekom Chair of Communication Networks” at TU Dresden coordinating the 5G Lab Germany. He is the spokesman of the DFG Cluster of Excellence CeTI. He received his diploma (Dipl.-Ing.) degree in electrical engineering from the University of Technology – Rheinisch-Westfälische Technische Hochschule (RWTH) – Aachen, Germany, in 1997 and his Ph.D. (Dr.-Ing.) in Electrical Engineering from the Technical University Berlin, Germany in 2002 and became Adjunct Professor at the University of Ferrara, Italy in the same year. In 2003 he joined Aalborg University as Associate Professor and later became Professor. He co-founded several start-up companies starting with acticom GmbH in Berlin in 1999. He has visited various research institutes including Massachusetts Institute of Technology (MIT), VTT, and Arizona State University. In 2005 he won the YRP award for the work on MIMO MDC and received the Young Elite Researcher Award of Denmark. He was selected to receive the NOKIA Champion Award several times in a row from 2007 to 2011. In 2008 he was awarded the Nokia Achievement Award for his work on cooperative networks. In 2011 he received the SAPERE AUDE research grant from the Danish government and in 2012 he received the Vodafone Innovation prize. In 2015 he was awarded the honorary degree “Doctor Honoris Causa” from Budapest University of Technology and Economy (BUTE). His current research interests are in the areas of wireless and 5G communication networks, network coding, cloud computing, compressed sensing, cross layer as well as energy efficient protocol design and cooperative networking.

Prof. Luca Sanguinetti (COM)
Department of Information Engineering
University of Pisa, Italy

Talk title: “Deep Learning Techniques for Massive MIMO” (provisional title)

Abstract: Transmit power in cellular networks is a key degree of freedom in the management of interference and energy. Power control in both uplink and downlink of cellular networks has been extensively studied, especially over the last 20 years, and some

of the results have enabled the continuous evolution and significant impact of the cellular technology. Traditionally, power control relies on the use of conventional optimization theory techniques that aim at optimizing the desired network utility functions, described in mathematical terms through theoretical considerations or based on models derived from field measurement campaigns. While this approach has served us well until the present fourth generation (4G) of wireless networks, it is anticipated to become problematic in future fifth generation (5G) networks. This is because the use of traditional optimization theory techniques is computationally feasible only when the network model is simple enough. On the contrary, 5G networks are anticipated to be extremely large and complex, due to the dramatic growth of connected devices as well as to the rise of innovative vertical services with heterogeneous and stringent performance requirements. In the presence of strong and time-varying multiuser interference, traditional power optimization techniques require an exponential complexity in the network size, which makes them not suited for practical applications in future cellular networks. Moreover, power control policies must be recomputed/updated every time the scenario changes, e.g. when a mobile terminal joins or leaves the network or when the propagation channel of a given mobile terminal changes as a result of mobility or simply of fading oscillations. This causes an unacceptable overhead, which prevents from using optimal online power control policies in complex networks, like 5G. The aim of this talk is to show how neural networks can be used to perform efficient power control in multicell Massive MIMO systems, which is the most attractive sub-6 GHz physical-layer technology for future wireless access. In particular, we will consider a sub-6 GHz multicarrier multicell Massive MIMO network that operates according to a synchronous time-division-duplex protocol and is affected by channel estimation errors, pilot contamination, and realistic channel models (reflecting the main characteristics of large antenna arrays) with non-line-of-sight (NLOS) and LOS components. The notable objective of this talk will be to describe how deep learning facilitates online uplink and downlink power allocation in Massive MIMO for the maximization of network utility functions. Particular attention will be devoted to the max-min fairness, max-product SINR (signal-to-interference-and-noise ratio) and max sum rate utility functions.

Biosketch: Luca Sanguinetti received the Laurea a postdoctoral associate in the Dept. Electrical Engineering at Princeton. During the period June 2010 - Sept. 2010, he was selected for a research assistantship at the Technische Universitat Munchen. From July 2013 to October 2017 he was with Large Systems and Networks Group (LANEAS), CentraleSupélec, Gif-sur-Yvette, France. He is currently an Associate Professor in the 'Dipartimento di Ingegneria dell'Informazione' of the University of Pisa, Italy. Dr. Sanguinetti has co-authored the textbook Massive MIMO Networks: Spectral, Energy, and Hardware Efficiency (2017). He served as Exhibit Chair of the 2014 IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP) and as the general co-chair of the 2016 Tyrrhenian Workshop on 5G&Beyond. He served as an Associate Editor for IEEE Transactions on Wireless communications, and as Lead Guest Editor of IEEE Journal on Selected Areas of Communications Special Issue on "Game Theory for Networks" and as an Associate Editor for IEEE Journal on Selected Areas of Communications (series on Green Communications and Networking). Dr. Sanguinetti is currently serving as an Associate Editor for the IEEE Signal Processing Letters and is a member of the Executive Editorial Committee of IEEE Transactions on Wireless Communications. His expertise and general interests span the areas of communications and signal processing. He received the 2018 Marconi Prize Paper Award in Wireless Communications and co-authored a paper that received the young best paper award from the ComSoc/VTS Italy Section. He was the co-recipient of two best conference paper awards: IEEE WCNC 2013 and IEEE WCNC 2014. He was the recipient of the FP7 Marie Curie IEF 2013 "Dense deployments for green cellular networks".

Prof. Marco di Renzo (COM)

Signals & Systems Lab. (CNRS - CentraleSupélec - Univ Paris-Sud) - France
Paris-Saclay University, France

Talk title: "Wireless Networks Design in the Era of Deep Learning: Model-Based, AI-Based, or Both?"

Abstract: Recently, deep learning has received significant attention as a technique to design and optimize wireless communication systems and networks. The usual approach to use deep learning consists of acquiring large amount of empirical data about the system behavior and employ it for performance optimization (data-driven approach). We believe, however, that the application of deep learning to communication networks design and optimization offers more possibilities. As opposed to other fields of science, such as image classification and speech recognition, mathematical models for communication networks optimization are very often available, even though they may be simplified and inaccurate. We believe that this a priori expert knowledge, which has been acquired over decades of intense research, cannot be dismissed and ignored. In this talk, in particular, we put forth a new approach that capitalizes on the availability of (possibly simplified or inaccurate) theoretical models, in order to reduce the amount of empirical data to use and the complexity of training artificial neural networks (ANNs). We concretely show, with the aid of some examples, that synergistically combining prior expert knowledge based on analytical models and data-driven methods constitutes a suitable approach towards the design and optimization of communication systems and networks with the aid of deep learning based on ANNs.

Biosketch: Dr. Marco Di Renzo was born in L'Aquila, Italy, in 1978. He received the Laurea (cum laude) and the Ph.D. degrees in Electrical and Information Engineering from the Department of Electrical and Information Engineering, University of L'Aquila, Italy, in April 2003 and in January 2007, respectively. In October 2013, he received the Habilitation à Diriger des Recherches (Doctor of Science) degree from the University Paris-Sud, Paris, France. He has held various research and academic positions in Italy at the University of L'Aquila, in the USA at Virginia Tech, in Spain at CTTC, and in the UK at The University of Edinburgh. Since 2010, he has been a CNRS Associate Professor (Chargé de Recherche Titulaire CNRS) in the Laboratory of Signals and Systems of Paris-Saclay University - CNRS, CentraleSupélec, Univ Paris Sud, France. He is a Distinguished Visiting Fellow of the Royal Academy of Engineering, UK. He is a co-founder of the university spin-off company WEST Aquila s.r.l., Italy. He is the Project Coordinator of the European-funded projects 5G-WIRELESS and 5G-AURA and a Principal Investigator of the European-funded projects GREENET, CROSSFIRE, WSN4QoL, SmartNRG, CASPER and of the French National Agency funded project SpatialModulation. Dr. Di Renzo is the recipient of a special mention for the outstanding five-year (1997-2003) academic career, University of L'Aquila, Italy; the THALES Communications fellowship (2003-2006), University of L'Aquila, Italy; the 2004 Best Spin-Off Company Award, Abruzzo Province, Italy; the 2008 Torres Quevedo Award, Ministry of Science and Innovation, Spain; the Dérogation pour l'Encadrement de Thèse (2010), University of Paris-Sud, France; the 2012 IEEE CAMAD Best Paper Award; the 2012 IEEE WIRELESS COMMUNICATIONS LETTERS Exemplary Reviewer Certificate; the 2013 IEEE VTC-Fall Best Student Paper Award; the 2013 Network of Excellence NEWCOM# Best Paper Award; the 2013 IEEE TRANSACTIONS ON VEHICULAR TECHNOLOGY Top Reviewer Award; the 2013 IEEE-COMSOC Best Young Researcher Award for Europe, Middle East and Africa (EMEA Region); the 2014 Royal Academy of Engineering Distinguished Visiting Fellowship,

United Kingdom; the 2014 IEEE ATC Best Paper Award; the 2014 IEEE CAMAD Best Demo Award; the 2014 IEEE CAMAD Best Paper Award; the 2014 IEEE WIRELESS COMMUNICATIONS LETTERS Exemplary Reviewer Certificate, the 2015 IEEE ComManTel Best Paper Award; 2015 IEEE Jack Neubauer Memorial Award; the 2015-2018 CNRS Award for Excellence in Research and in Advising Doctoral Students, the 2016 Marie Curie Global Fellowship, and the 2017 IEEE SigTelCom Best Paper Award. Currently, he serves as an Editor of the IEEE COMMUNICATIONS LETTERS and of the IEEE TRANSACTIONS ON COMMUNICATIONS (Heterogeneous Networks Modeling and Analysis). He is a Senior Member of the IEEE, a Member of the IEEE Communications Society and of the IEEE Vehicular Technology Society, and a Member of the European Association for Communications and Networking (EURACON). Since 2016, he has been a Distinguished Lecturer of the IEEE Vehicular Technology Society. Since 2017, he has been a Distinguished Lecturer of the IEEE Communications Society. Dr. Marco Di Renzo is a frequent tutorial speaker and lecturer at IEEE international conferences. During the last three years, he has presented 20+ tutorials on Spatial Modulation for MIMO Systems, 10+ tutorials on Energy-Efficient Wireless Networks, 20+ tutorials on Stochastic Geometry Modeling and Analysis of Wireless Networks, and 10 tutorials on Energy-Neutral Wireless Networks Design. In addition, he was Invited Lecturer, Invited Speaker and Invited Panelist at several IEEE events and Ph.D. schools.

Prof. Stavros Ntalampiras (COM)
Dept. of Computer Science "Giovanni degli Antoni"
University of Milan, Italy

Talk title: "Machine learning for audio signal processing"

Abstract: The seminar will cover both traditional machine learning technologies and recent advances w.r.t the area of audio signal processing. Focus will be placed on the way these have been employed to fulfill the needs of relevant audio signal processing applications, e.g. audio surveillance, biodiversity monitoring, speech emotion recognition, etc. Initially, the standard audio pattern recognition pipeline including handcrafted feature extraction and classification methods typically based on Support Vector Machines and Hidden Markov Models, will be explained. Subsequently, current trends will be described, including end-to-end sound processing based on deep neural networks, echo state networks, between-class learning, and variational autoencoders. The seminar will close with several examples demonstrating the application of transfer learning technologies on audio signals, while emphasizing the need for learning interpretable models in high dimensional spaces.

Biosketch: Stavros Ntalampiras is an Assistant Professor at the Department of Computer Science, University of Milan, Italy. He received the engineering and Ph.D. degrees from the Department of Electrical and Computer Engineering, University of Patras, Greece, in 2006 and 2010, respectively. He has carried out research and/or didactic activities at Politecnico di Milano, the Joint Research Center of the European Commission, the National Research Council of Italy, and Bocconi University. Currently, he is an Associate Editor of IEEE Access and PLOS One journals, as well as member of the IEEE Computational Intelligent Society Task Force on Computational Audio Processing. His research interests include content-based signal processing, audio pattern recognition, machine learning, and cyber-physical systems.

Prof. Sara Foresti (COMP)

Computer Science Department
University of Milan, Italy

Talk title: "Data security and privacy in emerging scenarios"

Abstract: Thanks to the rapid evolution and wide diffusion of Information and Communication Technologies (ICTs), our society is more and more relying on services offered at competitive prices by cloud providers. Clearly, these emerging scenarios bring considerable advantages. At the same time, they bring new security and privacy concerns, given by the loss of control over data and related confidentiality breaches. In this talk, I will illustrate some of the security and privacy issues arising in emerging scenarios, addressing in particular aspects related to data protection.

Biosketch: Giovanni Livraga is an assistant professor at the Computer Science Department, Università degli Studi di Milano, Italy. His research interests are in data privacy and security in emerging scenarios. His PhD thesis received the ERCIM STM WG 2015 award. He has been a visiting researcher at SAP Labs, France and George Mason University, VA (USA). He has been serving as PC member for several conferences.

Web: <http://www.di.unimi.it/livraga>

Prof. Alessandro Armando (COMP)
Dibris Department
University of Genova, Italy

Talk title: "Securing Distributed Applications: introduction to Cryptographic Protocols"

Abstract: Cryptographic Protocols are communication protocols that, by leveraging cryptographic primitives, ensure key security properties in distributed systems. Cryptographic protocols can be found in virtually all application domains: in the IoT they are key to security the interactions among sensors and actuators, in the web they are key to secure the communication between web browsers and application servers, in the financial sector they ensure the integrity and non-repudiation of financial transactions, etc. The lecture provides a gentle introduction to cryptographic protocols and exemplifies the security goals, assumptions, mechanisms as well as some common pitfalls and vulnerabilities by using a number of popular protocols as running examples.

Biosketch: Prof. Alessandro Armando received his M.Eng. and his PhD in Computer Engineering at the University of Genova. His appointments include a position as research fellow at the University of Edinburgh and one at INRIA-Lorraine (France). He is Full Professor at the University of Genova where he teaches Computer Security and has founded and coordinated a Master in Cybersecurity and Data Protection. In 2011 he founded (and led until 2016) the Security & Trust Research Unit of the Bruno Kessler Foundation in Trento. He has been coordinator and/or team leader in several national and EU research projects, including the AVISPA, AVANTSSAR, SpaCIoS and SECENTIS projects. He contributed to the discovery of an authentication flaw in the SAML 2.0 Web-browser SSO Profile and of a serious man-in-the-middle attack on the SAML-based SSO for Google Apps. He is currently serving as vice director of the CINI National Cybersecurity Laboratory.

Prof. Fabio Roli (COMP)

Talk title: "Cybersecurity after the Rise of Adversarial Machine Learning"

Pattern Recognition and Applications Lab

University of Cagliari, Italy

*If you know the enemy and know yourself,
you need not fear the result of a hundred battles*
Sun Tzu, The art of war, 500 BC

Abstract: Machine-learning algorithms are widely used for cybersecurity applications, including spam and malware detection. In these applications, the learning algorithm has to face intelligent and adaptive attackers who can carefully manipulate data to purposely subvert the learning process. As machine learning algorithms have not been originally designed under such premises, they have been shown to be vulnerable to well-crafted, sophisticated attacks, including test-time evasion and training-time poisoning attacks (also known as adversarial examples). This talk aims to introduce the fundamentals of adversarial machine learning by a well-structured overview of recently-proposed techniques to assess the vulnerability of machine-learning algorithms to adversarial attacks (both at training and test time), and some of the most effective countermeasures proposed to date. We report application examples including object recognition in images, biometric identity recognition, spam and malware detection.

Biosketch: **Fabio Roli** is a Full Professor of Computer Engineering at the University of Cagliari, Italy, and Director of the Pattern Recognition and Applications laboratory (<http://pralab.diee.unica.it/>). He is partner and R&D manager of the company Pluribus One that he co-founded. He has been doing research on the design of pattern recognition and machine learning systems for thirty years. His current h-index is 59 according to Google Scholar (Jan. 2019). He has been appointed **Fellow of the IEEE** and **Fellow of the International Association for Pattern Recognition**. He was a member of **NATO advisory panel** for Information and Communications Security, NATO Science for Peace and Security (2008 – 2011).

Lodging and Registration

The info below can also be found at: <http://ssie.dei.unipd.it/whenwhereaccomodationregistration/>

1. All Lessons will be at the: Casa della Gioventù, via Rio Bianco, 39042 Bressanone (BZ), Italy

2. 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.

3. Student workshop/presentations

The school will feature a student workshop, where students will present their research activity. Each presenter will be assigned a slot of **20 minutes**, including **5 minutes** for questions. All presentations will be in English. Submission of presentation proposals from participants shall be done through the registration form at the link: <http://ssie.dei.unipd.it/proposals/>

Due to the limited number of time slots (10 max.), the organizing committee will select 10 talks from those submitted based on the research topics and any supporting material that will be linked by the student (e.g., research paper, Webpage and/or You Tube video). **The best presentation will receive an award from the IEEE Sensor Council Chapter - Italy Section.**

The deadline for submitting proposals is June 20, 2019.

4. Registration & Fee

The registration fee is: 80 euros for IEEE members (any grade), 120 euros for non-IEEE members.

Registration and payment are handled by the IEEE, please use the following link:

<http://sites.ieee.org/italy/ssie-2019-registration/>

The deadline for registering is June 15, 2019.

5. Accommodation

We have an arrangement with **Grüner Baum Hotels** (www.gruenerbaum.it) in Bressanone (Brixen), one of the best hotels in town, which will provide lodging at unbeatable discount prices for the school participants. The prices for SSIE 2019 are:

single room	75.00 Euro per person per day (breakfast included)
double room	60.00 Euro per person per day (breakfast included)
double room (single person)	105.00 Euro per person per day (breakfast included)
half pension supplement	18.50 Euro per person per day
meal	10.00 Euro for a first course

Sojourn Taxes: Euro 2.90 per person/night. Included in the offer:

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

Reservation means: each participant shall independently book her/his room for the dates of interest. Extensions to one/two days beyond the school dates are possible at the above special rates. Reservation can be placed by phone (+39 0472 274 100), fax (+39 0472 274 101) or email (info@gruenerbaum.it) with reference to: PhD summer school "SSIE 2019". Either a credit card number or a deposit of 75.00 euros per room will be required. A number of rooms will be reserved for SSIE participants until **June 8, 2019.**