Collegio dei docenti del Corso di dottorato in Ingegneria dell'informazione

14 novembre 2018

Proposte di assegnazione del supervisore e dell'argomento di tesi ai dottorandi del 34° ciclo

Dottorando: **Amadio Fabio**
Supervisore: Prof. Ruggero Carli
Thesis topic*:* Model-based Reinforcement Learning for Robotics
Thesis main objectives: In order to enable robots to act autonomously, *reinforcement learning* approach seems to be a promising solution, with its capacity of learning and improving control strategies from experience. Current methods often use *deep neural networks*, which are powerful tools but heavily data inefficient. This inefficiency is an important obstacle in robotic applications, being very expensive and time-consuming to collect big set of data in this context. The main interest in my research is to develop *model-based* methods to obtain a more sample efficient learning, able to adapt to various tasks. This approach aims to learn a dynamics model of the system to be used in the definition of the control strategy, for example using *model predictive control* in order to choose actions to be taken.

Dottorando: **Barbiero Marco**
Supervisore: Prof. Prof. Luca Schenato
Thesis main objectives: The project, carried on in partnership with EDILVI S.P.A., consists of designing a platform to collect and elaborate data coming from sensors installed in houses and building. The aims of the sensors are to monitor and predict in real-time the energy consumption and the status of the building (temperature, relative humidity, gasses, etc..). This information will be used to (i) verify a-posteriori whether the building meets the project's a-priori performance requirements or not, (ii) to interact with users to promote energy saving behaviours, (iii) to perform predictive control and maintenance. For promoting energy saving behaviours, it is fundamental to monitor the comfort and, for this reason, some research should also be done in this topic. The main milestones that will be pursued are: Select the necessary hardware/software elements to achieve the desired objective (type of sensors, communication infrastructure and data-base software). Develop a dynamical model for smart buildings (thermodynamics + user behaviours) Find a definition of comfort that can be used to control the environment. Develop algorithms for a-posteriori energy consumption analysis Develop algorithms for real-time predictive control/maintenance. Build a fully working platform where to implement and test the previous algorithms.

Dottorando**: Bastianello Nicola**
Supervisore: Prof. Ruggero Carli
Thesis main objectives: The topic of my thesis is the development of distributed optiisation algorithms that have convergence guarantees in realistic scenarios, in particular: in the presence of loss of communications between nodes, asynchronous updates of the nodes and switching topologies of the communication graph. Moreover, time-varying optimization problems will be evaluated as well.
The thesis will be divided in two main branches, a first that has the aim of adapting results from operator theory to the realistic distributed problems of interest and exploit them to derive the desired convergence results. The second branch will be focused on designing time-varying optimisation algorithms based on the prediction-correction framework. Finally, the results obtained

within the two sections will be brought together into a complete and general framework for distributed optimisation.

Dottorando: **Bodo Roberto**
Supervisore: Prof. Matteo Bertocco
Thesis main objectives: "Recent introduction of network technologies and embedded calculus systems with low power consumption enables new functionalities in HVAC/R (Humidity Ventilation Air Conditioning and Refrigeration) systems. In particular, machines and plants could be rethought in cyber-physical domain in which single parts, equipped with autonomous intelligence, mutually cooperate to fulfil different functional targets. In this scenario, the PhD program focus on technologies and system architectures through a cyber-physical modelling approach capable of self-learning and adapt to external stimuli. Interesting applications of these techniques regard predictive maintenance, distributed diagnosis and IOT enabling architectures, behavioural modelling, efficiency improvement and social networks integration. "

Dottorando: **Bonanno Giovanni**
Supervisore: Prof. Luca Corradini
Thesis main objectives: Analysis and design of current-mode control techniques for multilevel dc-dc converters.
The core of the proposed project is the analysis and design of the current-mode techniques for multilevel converters. One of the most important proposed tools are the describing functions. The goal is to substitute the transfer function with this more accurate mathematic tool in order to properly model the non-linearity of the dc-dc converter.
Precisely I am searching tools capable to model, in a unified way, the dynamic behaviour of the multilevel dc-dc converters. In fact, some issues, as sub-harmonic oscillation, are not predicted by the conventional approaches also for the traditional converters (e.g. classic two levels buck converter).

Dottorando**: Camerlingo Nunzio**
Supervisore: Prof. Giovanni Sparacino
Co-Supervisore: Andrea Facchinetti
Thesis topic: Identification and Management of Behavioral Determinants for Hypoglycemia in Type 1 Diabetes via Simulation Modeling Approaches.
Thesis main objectives: In the daily management of the chronic Type 1 diabetes (T1D) disease, the fear of hypoglycemia is the major barrier in preventing people with diabetes achieving glucose levels necessary to avoid diabetic complication, since its occurrence may cause acute cognitive disfunction, coma, seizure or even death. The risk of hypoglycemic events also reflects some factors connected to the patient's behavior. To mention but a few: i) errors in carbohydrates counting; ii) errors in insulin bolus administration; iii) responsiveness to hypoglycemic symptoms; iv) occurrence of missed boluses. In the literature, there are no quantitative results available on both the absolute and relative role of these different behavioral factors in influencing hypoglycemia frequency and duration. Such an information might be of dramatic importance for improving the T1D therapy. Given the impossibility of studying the influence of the above mentioned behavioral risk factors in vivo, during this Ph.D. program a simulated framework will be developed. Specifically, we will first devise key behavioral submodels and then integrate them within state-of-

art diabetes simulation models. Finally, we will perform model validation by using datasets available to the Bioengineering research group via its network of international collaborations.

Dottorando: **Capuzzo Martina**
Supervisore: Prof. Andrea Zanella.
Thesis topic: Enabling Wireless technologies for Industry 4.0.
Thesis main objectives: Built upon the grounds laid by the widespread digitalization and Internet connectivity, the Industry 4.0 aims at connecting all production means in the industry field, enabling real-time machines self-control and monitoring, lowering energy and maintenance costs and introducing smarter production processes. The success of these applications is based on communications providing low latency and ultra high reliability in (wireless) networks hosting a big number of nodes transmitting traffic with various patterns.
The objective of this research project is to investigate in depth the requirements and use cases of the different applications and evaluate possible solutions to fulfill them. The analysis will focus on the existing and promising technologies, evaluating their capabilities in terms of scalability, latency and reliability, identifying their strengths and weaknesses and proposing enhancements and alternative techniques for better performances. Finally, the investigation of a complete industry scenario where multiple technologies coexist together and provide the required communication is envisaged.

Dottorando: **Chiarello Leonardo**
Supervisore: Dr. Nicola Laurenti
Thesis main objectives: GNSS signals are vulnerable to interference due to being extremely weak when they are received on Earth's surface. For what concern intentional interference, two categories exist: jamming and spoofing, that is, denial of service and to induce a false position and time, respectively. My research activity is inserted into this context and it focuses on authentication and integrity protection of GNSS signals. In particular, during this first month of the Ph.D. Course I started working on the design of some consistency checks in order to detect if a spoofing attack is in act. For example, one of them is based on the comparison between the position given by GNSS and the outputs of some inertial sensors. In the short term I will continue working on these topics and possibly on the improvement of an existing defense that I mislead with an attack designed in my master thesis. The general idea is to continue developing anti-spoofing and anti-jamming techniques that protect both acquisition and tracking stages of a GNSS receiver.

Dottorando: **Cunico Daniel**
Supervisore: Prof. Angelo Cenedese
Thesis topic: Dynamic modeling and soft sensing techniques for industrial motion control.
Thesis main objectives: The research project focuses on the study of motion control in access automation systems with particular reference to fault/anomaly detection, impact phenomenon response analysis, intrinsic safety and self-adaptation.
The application domain for these issues regards system performance optimization, soft-sensing and datadriven procedures for health monitoring and remote tuning, and all these tasks falls within the main objective to define a generalized robust methodology for dynamic estimation and automatic control for access control systems.
The proposed PhD programme foresees a balanced mix of methodological and technological aspects, and in this sense, emphasis will be given to modular modeling and simulation methods, implementing models and algorithms that can simplify and speed up the development process and increase the performances with respect to the current state of art. In particular, machine learning techniques will be used for system and event characterization, and adaptive parameter tuning, while

efficient motion control methods and soft sensing schemes will be designed based on standard off-the-shelf products.

Dottorando: **Fabris Erika**
Supervisore: Prof. Gianmaria Silvello
Thesis topic: Automatic knowledge extraction, nanopublications creation and statement verification.
Thesis main objectives: Nanopublications are a recent Linked Data format for publishing scholarly data which consists of an atomic statement in the form of a triple (subject/predicate/object) and a set of annotation on it about where this piece of information came from. This format have been proposed to facilitate the retrieval and sharing of scholarly information and to make reusable scientific facts and it is already in use mostly for Life Science domains.
The aim of the research project is the design and development of a system to automatically extract from scientific documents or other sources of knowledge irreducible pieces of information, store them as nanopublications building a sort of knowledge base and provide methods to verify if an input statement contradicts existing assertions.

Dottorando**: Faccioli Simone**
Supervisore: Dr. Simone Del Favero
Thesis main objectives: My research will deal with the therapy and management of Type 1 Diabetes, also in relation to the development of the Artificial Pancreas (AP) technology.
In particular, the purpose of my thesis will be the exploration and assessment of new prediction strategies and methods to individualize and to improve the control algorithm of the AP.
To cope with the wide inter- and intra-subject variability present in this problem, we can learn and update patient-specific predictive models of the glucose-insulin system, and use them to design personalized control actions.
Specifically, we have three objectives:
1) exploring new data-driven techniques for model identification (parametric, non-parametric, linear or piece-wise linear);
2) include physical activity information as a new input for the models;
3) developing a strategy to anticipate meal consumption, an important disturbance for the system.
By reaching these objectives, we could make the diabetes therapy:
- preventive, since a better control can decrease short- and long-term risks, and patients' effort;
- proactive, since predictions can be used to safely and promptly anticipate control actions;
- personalized, thanks to patient-specific models and control.

Dottorando: **Ferro Fabiana**
Supervisore: Prof. Alessandro Beghi
Thesis main objectives: Aim of my project is to make some Santex Rimar Group machines compliant to the industry 4.0 requirements, focusing my studies on the development of advanced control and maintenance techniques, to guarantee the desired product quality and system efficiency. In particular, I will identify a pilot machine and I will model its main phenomena of interest. I will therefore exploit that model for the creation of a proper simulation environment, used as a synthetic data generator to design and test control algorithms.
I will also focus my studies on the development of anomaly detection techniques. In this context, I will explore the use of model-based and/or data-driven techniques. Specific datasets (some of them

available from literature and others provided by Santex Rimar Group) will be used to train and test the anomaly detection algorithms.

Dottorando: **Foletto Giulio**
Supervisore: Dr. Giuseppe Vallone
Co-Supervisore: Prof. Paolo Villoresi
Thesis topic: Generalized measurements and their role in modern quantum technologies.
Thesis main objectives: The second quantum revolution needs reliable ways to harness information from quantum systems; in particular, the detectors used in communications can benefit from new measurement strategies to verify their readings. To realistically describe the behavior of such devices, it is necessary to generalize the simplistic model of projective observations and study the measurement process in its details, which in turn might also shed light on some fundamental open problems of quantum physics. The purpose of this project is to investigate these generalizations and thus find clever protocols to observe quantum systems, with a focus on state and process reconstruction, two key ingredients of many quantum technologies. The final goal is to incorporate these techniques in the communication schemes currently under development at Quantum Future.

Dottorando**: Fregonese Luca**
Supervisore: Prof. Stefano Vitturi
Thesis topic: Time Sensitive Networking for real—time communication in the context of factory automation and process control systems.
Thesis main objectives: Project summary: Analysis of the TSN framework performance in the context of soft and hard real-time flows of data. In particular it is necessary to evaluate the ability of TSN to fulfill the requirements of industrial communication in terms of real-time and determinism.

- Evaluation of potential and limits of integrating OPC UA over the above lower-level communication protocol.
- Development of network simulation models.
- Development of an experimental setup in order to validate the theoretical and simulated results.

Dottorando: **Jain Abhishek**
Supervisore: Prof. Simone Gerardin
Thesis main objectives: "Innovative analysis methods and new robust solutions to mitigate the impact of ionizing radiation effects in digital chips".
Project Objectives – The research project will initially aim at understanding and quantifying the impact of radiation strikes on state-of-the art technologies. The focus will be on the estimation of radiation induced faults on digital logic IPs (Standard Cells, SRAM, eNVM, etc) and microprocessor-based systems, using STMicrolectronics technologies as a case study. The research work aims to devise efficient mitigation techniques at cell level and architecture level to improve the robustness factor according to the intended application. Dedicated test-chips will be fabricated on ST BCD process for carrying out this study and validation. Another aspect of the project will be based on building a methodology to estimate SER rate at cell level as well as chip level through CAD tools in order to enable designers to adopt best methodologies to improve the robustness of their circuit.

Dottorando: **Lecci Mattia**
Supervisore: Prof. Michele Zorzi
Thesis topic: Evaluation and Improvements of mmWave 802.11 protocols and systems.
Thesis main objectives: In the last few years, mmWave has been a central topic in the telecommunication research field. While many issues of this higher frequency radiation have been solved, many others still need to be addressed to unleash its full potential.
During my PhD, I plan to expand the knowledge of the research community in topics that still lack proper solutions. Among these, a first objective is to perform a cross-layer analysis of beamforming techniques, seeking for requirements in the beamformed antenna pattern yielding stable performance from a full-stack perspective. Mobility and blockage in a directional-communication paradigm are still problematic, especially for fast-moving devices (e.g. V2X). Both classical signal processing and modern machine learning algorithms will be explored to find a solution. A thorough revision of legacy mechanism (e.g. RTS/CTS, NAV) will be done in order to understand whether they can still be used, whether they can be improved and how their presence affects performance. Following this, a new network architecture fundamentally based on imperfect directional communication will be defined; new, more realistic channel models that consider propagation in practical environments will be carefully considered in the design of this architecture. Finally, a mathematical modeling of IEEE 802.11ad and the upcoming 802.11ay will be done to understand the tradeoffs between the parameters of such complex systems.

Dottorando: **Ma Teng**
Supervisore: Prof. Alessandro Paccagnella
Argomento tesi: The aggressive downscaling of deep-submicrometer CMOS technologies bring analog and mixed-signal circuits the benefits of a higher operation speed and an extended circuit functionality. More often, advanced CMOS technologies are used in radiation harsh environments (space, High Energy Physics experiments, medical). Their reliability degradation modes and mechanisms are becoming more complex and intriguing as the feature size of the chip decreases. In my research activity, I plan to investigate 28 and 65 nm bulk MOSFETs as typical research objects, and to study the radiation effects (total ionizing dose, single event effects, and possible synergetic effects), post-irradiation reliability (such as HCI, NBTI, and TDDB). I intend to analyze radiation tolerance with different radiation sources. The research results could provide insights in the new failure mechanisms of scaled technologies, and give useful guidance and technical support for the radiation hardening of high-end core CMOS technologies, in order to improve application reliability in harsh radiation environments.

Dottorando: **Maguolo Gianluca**
Supervisore: Prof. Loris Nanni
Thesis topic: Ensemble Methods Based on Deep Learning.
Thesis main objectives: The project consists in improving current classification methods using deep neural networks. The idea is to investigate how different network topologies find different patterns in the data. For example, it has been shown that, combining multiple different networks, the overall prediction is better than the one of every single network. The first part of the project will deal with convolutional neural networks (CNNs) for image and audio data, however this is a very general approach that might lead to a wide range of applications.

Dottorando: **Marcon Gianluca**
Supervisore: Prof. Marco Santagiustina

Thesis main objectives: *Raman Amplification in Spatial Division Multiplexed Systems* - With the relentless increase of internet traffic during the last decade, the network of single-mode optical fibers (SMFs) currently deployed will soon reach its capacity limit. To overcome this impending issue, the optical fiber community proposed a new trasmission scheme, called Spatial Division Multiplexing (SDM), which permits the parallel transmission of multiple data streams using the only degree of freedom left in optical fiber communications: space. My research activity will cover the study of optical amplifiers for SDM systems based on the Stimulated Raman Scattering (SRS) effect. In particular, Raman amplification will be studied for two different types of fibers used for SDM, namely few-mode fibers (FMFs) and multi-core fibers (MCF). Through the use of both analytical and numerical methods, the effect of channel-coupling and different fiber geometries on the amplification characteristics of the device will be assessed. Equalization of the amplifier gain over the trasmitted channels and over a broad bandwidth will also be part of the research activity, as it will allow for simplified receiver configurations and compatibility with other technologies such as Wavelength Division Multiplexing (WDM). The ultimate goal is to develop a mathematical model that can accurately describe these phenomena and that can be used for the design of Raman Amplifiers for SDM links.

Dottorando: **Meneghello Francesca**
Supervisore: Prof. Michele Rossi
Thesis main objectives: During my three years Ph.D. I'll investigate the use of mmWaves to perform radio frequency (RF) sensing. RF sensing enables a number of tasks (e.g. human and obstacle detection, activity and gesture recognition) that are important for different applications such as e-health assistance and movement tracking for virtual and augmented reality. Up to now RF signals in the sub-6 GHz spectrum have been widely used to perform RF sensing while the use of the spectrum above 6 GHz is less studied. The usage of RF systems to perform sensing is an advantage because it is transparent to the end-user and does not require the recording of video of the subjects. My purpose is to study the feasibility and the performance of sensing using mmWave spectrum. In particular I'll focus in the development of algorithms for indoor sensing using directional arrays at mmWave frequencies, capable to recognize different movements in a variety of environments. The algorithms will be evaluated in real-world scenarios using multi-radio testbed.

Dottorando: **Michieli Umberto**
Supervisore: Prof. Pietro Zanuttigh
Thesis topic: Semantic Segmentation for Deep Scene Understanding in Real World Applications.
Thesis main objectives: During my Ph.D. I would like to investigate several aspects of semantic segmentation. First of all, I plan to use multiple sources of information such as color images and three-dimensional geometrical data starting from previous works in the LTTM laboratory with particular attention devoted to improve the accuracy of the shape of the regions corresponding to the labels.
Then I aim at proposing a novel classification scheme, trying to generate multiple labels and possibly nest or merge them hierarchically so that an artificial intelligence could be able to interpret at many levels the scene content.
Another focus of my Ph.D. would be the development of frameworks which require only few manually labeled data samples, since they are usually inaccurate and the labeling operation is highly time consuming, trying to reinforce the learning process with other data without ground-truth labels (e.g exploiting semi and weakly supervised deep learning techniques based on Generative Adversarial Networks).

Finally, it could be extremely interesting to apply such techniques real-time on videos since many applications could benefit from this.

Dottorando: **Morato Alberto**
Supervisor: Prof. Stefano Vitturi
Thesis topic: Industrial Internet of Things for the connection of industrial electrical drives.
Thesis main objectives: In accordance with the labor market demand for new technologies that can increase the productivity, quality and safety of industrial processes (Industry 4.0), the project aims at the study, analysis and development of intelligent control systems for distributed electrical drives connected via field bus with integrated functional safety. The project lies within an industrial reality and aims to develop an electrical drive with Safety Integrity Level 3 (SIL3) according to IEC61508 and IEC61800, that communicate with other safe devices in the network via Fail Safe over EtherCAT (FSoE).
In particular, the objectives concern:
* Study and development of a hardware and software platform with Safety Integrity Level 3 able to communicate through the FSoE network protocol and able to perform the required safety procedures.
* The protocol aspects of industrial communication and the system infrastructure to ensure adequate performance and efficiency
* Study of systems for the identification and mitigation of faults in the execution of safety functions through the cooperation of electric drives connected via field bus
* Extension of the concept to wired / wireless and multi-protocol hybrid networks

Dottorando: **Nicola Giorgio**
Supervisore: Prof. Stefano Ghidoni
Thesis topic: Motion planning in Human-Robot Collaboration for industrial applicatiion.
Thesis main objectives: The aim of the research is the development of a framework for motion planning to enhance humanrobot collaboration in industrial application. The research work will face three topics: 1) Motion planning with human obstacles 2) Identification of human co-worker actions 3) Task planning according to human actions. The core of the research will be the implementation of novel motion planning algorithms with particular attention to Deep Reinforcement Learning methods. The developed methods will aim to create plans that are collision-less and optimal regarding to collaboration effectiveness. Identification of human activity and task planning will be implemented with current state of art methods. The final objective of the research project will be the deployment of an experimental scenario of human-robot collaboration where all the topics researched will be implemented and evaluated.

Dottorando**: Pezzutto Matthias**
Supervisore: Prof. Luca Schenato
Thesis topic: Controllo cooperativo tramite Wi-Fi.
Thesis main objectives: Il progetto di ricerca riguarda il controllo di sistemi multi-agente in cui le comunicazioni avvengo tramite una rete Wi-Fi. Il primo obiettivo è realizzare un controllore che impieghi Wi-Fi, robusto alla perdita di pacchetto e ai ritardi aleatori, nel caso di un sistema con un unico agente. Il secondo obiettivo prevede lo studio in maniera distribuita della traiettoria, formulando il problema come un problema di ottimizzazione distribuita. Il terzo obiettivo consiste nell'unione dei risultati ottenuti nei primi due punti, generalizzando il controllore per il singolo agente e considerando le interazioni con gli altri agenti. Parallelamente, aspetti della comunicazione Wi-Fi devono essere indagati per ottimizzare la sua applicazione nel caso di studio.

Dottorando**: Piva Francesco**
Supervisore: Prof. Matteo Meneghini.
Thesis main objectives: The aims of my studies are the identification, the study and the modeling of the physical mechanisms that limit the efficiency and the reliability of optoelectronic devices based on compound semiconductors. To achieve this goal, I will investigate the following processes: low Internal Quantum Efficiency (IQE), low Extraction Efficiency (EE), low Injection Efficiency (IE), defects generation in the material, activation of the dopant atoms, contact degradation, generation and modification of parasitic emission spectral bands. All this information will allow to develop a physical model of the degradation phenomenon and derive prediction techniques of the sample lifetime in nominal condition. At the end, all this data will be use to define the physical models parameters for the device PC simulation, to support the future structure design.

Dottorando: **Purpura Alberto**
Supervisore: Dr. Gianmaria Silvello
Co–Supervisore: Dr. Gian Antonio Susto.
Thesis main objectives: The field of my research project will be Information Retrieval; in particular, it will be focused on the study of deep learning methods for the retrieval of textual documents.
This problem consists of computing a ranking of the documents in a collection with respect to a user's information need. His/Her information need is expressed by means of a sequence of keywords. Machine learning and in particular neural networks have already shown promising results in this task [1, 2], but there are still lots of open issues to be studied. First, the "vocabulary mismatch" problem, i.e. the problem of retrieving relevant documents when the terms employed by a user to describe his/her information need, are different than the ones found in a corpus.
The second big open issue in this field is learning a representation of words for this task which can capture their meaning. This problem has been referred to as distributional semantics. The main outcome of this project will be the development of a system for information retrieval, which can solve the two mentioned problems, using deep learning techniques.
[1] Onal KD, Zhang Y, Altingovde IS, Rahman MM, Karagoz P, Braylan A, Dang B, Chang HL, Kim H, McNamara Q, Angert A. Neural information retrieval: At the end of the early years. Information Retrieval Journal. 2018 Jun 1;21(2-3):111-82.
[2] Mitra B, Craswell N. Neural Models for Information Retrieval.
arXiv preprint arXiv:1705.01509. 2017 May 3.

Dottorando: **Rossi Alessandro**
Supervisore: Prof. Ruggero Carli
Thesis topic: Development of an image simulator to generate test datasets suitable for training Deep Learning systems.
Thesis main objectives: Deep Learning has certainly brought enormous benefits to Computer Vision and one of the main issues regards the availability of data to train those systems. To solve this problem, we intend to design a simulator of 3D scanners and 2D cameras to generate, in negligible time, artificial test datasets. To obtain a realistic simulator we need to emulate the most common 3D scanners (structured light, stereo vision,time of flight and laser) and incorporate the optics to simulate 2D cameras and image distortion effects.
The research objectives are essentially three:

- Continue the work started during my master thesis, developing a complete and realistic simulator;
- Deeply study and implement an identification system based on an inference engine;
- Test all the algorithms to verify the performance of the simulator in producing test datasets.

Dottorando: **Samparisi Fabio**
Supervisore: Dr. Luca Poletto
Thesis topic: "Beam conditioning and photon handling of ultrafast pulses in the soft X-ray spectral region".
Thesis main objectives: The main topic is the science of ultrafast optical pulses, also called "attosecond science". This new field of optics employs extremely short light pulses in order to study the dynamic behavior of atomic and molecular systems, in fact, structural deformations and electronic motion typically occur at the femtosecond and attosecond timescale.
The first main objective of this project is the design and the characterization of a monochromator for ultrafast pulses to be installed at the Extreme Light Infrastructure (ELI-ALPS) in Szeged, Hungary. The monochromator is a dedicated instrument which will be used to select one single harmonic within the broad spectral band covered by the facility light source, while preserving the extreme short duration of the pulse. In the first part of the project, that is the optical design of the instrument, a ray-tracing software will be exploited. Next, the optical components will be aligned and the system will be analyzed to quantify residual aberrations. Eventually, the spectral characterization and the measurements of the temporal performances of the instrument will be performed.
The second part of the project involves the realization of an ultrafast beamline for high-repetition rate experiments in collaboration with the Institute of Physics of the University of Freiburg, Germany. The beamline will employ a fiber-based laser to generate soft X-ray radiation. It will be possible to generate soft X-ray pulses shorter than 100 fs. The main activity here will be the realization and test of such a beamline: from the optical design to the thermal, spectral and temporal characterization of the system.

Dottorando: **Signori Alberto**
Supervisore: Prof. Michele Zorzi
Thesis main objectives: In the last years, heterogeneous and multimodal wireless underwater networks, composed by both fixed nodes and underwater vehicles have been gaining more and more interest in both scientific and industrial areas. In these networks, the nodes can communicate combining different technologies (acoustic, optical, radio-frequency) to exploit the advantages of each one.
Multimodal networks can be exploited in different scenarios, such as the remote control of underwater vehicles, underwater wireless sensor networks and data-muling. To exploit these networks in these scenarios, efficient communication protocols need to be designed to mitigate effects such as large propagation delay, low bitrate (in acoustic communications) or short communication range (in optical and radio-frequency communications) that affect underwater networks. The design and the implementation in a network simulator of these protocols and sea trials for the validation of the simulated performance will be essential to enhance the capabilities of these type of networks.

Dottoranda: **Slasko Weronika Joanna**
Supervisor: Prof. Zimi Sawacha

Thesis topic: Electromiography as a tool for identifying biomarkers of diabetes and its related compications.
Thesis main objectives: The aim of the project is to identify muscles alterations in diabetic and diabetic subjects with different complications (neuropathy, vasculopathy and so far) while performing different task, in order to prevent diabetic foot pathology. With this respect different parameters will be extracted from the electromiographic signals and different algorithms will be adopted. Data mining techniques and regression analysis will also be used in order to explore the best predictive dataset to be used as an aid in diabetic foot prevention. The necessary dataset will include both data extracted from the BiomovLab database (trainer dataset) and a new set of data acquired during the second year for validation purposes. Both control and diabetic subjects with different complications will be acquired. A universal application for processing the EMG signal will be devised, that enables noise detection and removal, determination of threshold of muscle activity, detection of timing of muscle activation and deactivation, identification of electrical manifestation of muscle fatigue, and extracting data for further statistical analysis.

Dottorando: **Tonon Andrea**
Supervisore: Prof. Fabio Vandin
Thesis main objectives: The objective of my research project is to develop novel scalable methods for the extraction of patterns from sequential data.
In particular, it will focus on developing an efficiently computable bound on the number of samples needed for mining sequential patterns, using concepts from statistical learning, s.t. VC-dimension and Rademacher Complexity. I will first consider frequent sequential pattern mining, where the frequency of the patterns which appear in the dataset is the sole criterion to select the patterns, and then significant pattern mining, where alternative statistically sound relevance measures are used in the extraction.
Finally, I will consider other types of sequential data, i.e. time series and evolving networks, exploiting the methods developed for sequential patterns for these others types of sequential data.
In the development of these techniques I will also study the use of distributed/parallel computation approaches, based on the MapReduce paradigm.

Dottorando: **Varotto Luca**
Supervisor: Prof. Prof. Angelo Cenedese
Thesis Topic: Modelling and control techniques for smart camera networks.
Thesis main objectives: This research activity is focused on smart camera networks. Smart cameras combine sensing, processing and communication capabilities. The main purpose is to exploit this innovative technology to develop efficient visual sensor systems. The starting point will be the exploitation of distributed optimization strategies to study solutions for automatic network calibration. The obtained results will be the basis for the analysis of canonical problems like cooperative coverage, event detection and target tracking. All these applications will be studied using methodologies related to consensus estimation, graph theory and machine learning, with the aim of developing networks in which the cameras will be able to perform optimal task assignment and self-reorganization (i.e., they will communicate and learn from experience in order to adapt to diff erent conditions).

Dottorando: **Veni Simone**
Supervisor: Prof. Andrea Bevilacqua

Thesis main objectives: The main topic of this research project concerns the study of different topologies and techniques to minimize the phase noise in 5G communication systems (mm-waves), in particular focusing on the voltage controlled oscillators.
The name of the particular topology under analysis is LC series-resonance oscillator. This is a new topology which has not been examined thoroughly, but it is worth exploring. Its theoretical performance is much better than the most famous and used voltage controlled oscillators with LC parallel-resonance, but there are still lots of problems to analyze: for example one of these is to maintain the oscillation and to achieve the performance given by theory.
Starting from the study of this topology, the aim is to obtain some working chips with low phase noise and to publish some theoretic studies and interesting results.

Dottorando: **Wang Benyou**
Supervisor: Prof. Prof. Massimo Melucci
Thesis Topic: Dynamic Content Monitoring and Exploration using Vector Spaces.
Thesis main objectives: The aim of this project is to investigate a methodology to support specialists in monitoring, exploring and interacting with (thematic) issues in unstructured and dynamic corpora; examples are informative resource streams or corpora that involve a long time span such as set of newspaper articles, blog posts, journal paper collections, or historical document collections. The methodology will rely on representation(s) based on abstract vector spaces. The representations will be designed in order to be suitable for enrichment , generalisation, specification performed manually by the specialist or automatically by the system (e.g. exploiting profiles) though operations on vector spaces, thus providing specialists with representation tailored to their field and task. Indeed, even when considering the same issue, tailored representation can be beneficial to different specialists (e.g. historians, journalists or sociologists) for instance in terms of the level of technicality or verbosity.
Moreover, issue monitoring based on different representations or issue comparison can provide useful insights for specialist analyses.

Dottorando: **Zampieri Alessandra**
Supervisor: Prof. Prof. Angelo Cenedese
Thesis topic: Modeling and control strategies for smart lighting systems.
Thesis main objectives: The project is composed by two main phases.
1) A methodological phase in which the objective will be the study of the techniques applied to sensor networks and lighting actuators, in particular with regard to:
- distributed methodologies**:** to optimize the performance of the lighting system;
- personalized control and estimation methodologies**:** considering the possibility to adapt the lighting level according to user requirements, for example according to the expected traffic flows, which can be estimated;
- fault/event detection of sensor and process methodologies**:** to detect anomalies in the environment while at the same time guarantee a level of performance.
2) A phase of a more applicative nature, in which a specific scenario of interest will be defined for a self-reconfigurable smart-lighting network.

Dottorando: **Zancato Luca**
Supervisor: Prof. Alessandro Chiuso
Thesis topic: Deep Artificial Neural Networks and Stochastic Optimization.
Thesis main objectives: The purpose of the thesis is to provide advances in the understanding of the learning process of Deep Neural Networks. In particular, we shall address the following issues:

(i) how the network architecture affects the empirical loss landscape and (ii) in which way stochastic optimisation algorithms favour generalisation capabilities of Deep Neural Networks.
We shall study the EMPIRICAL LOSS GEOMETRY and how stochastic optimisation methods are able to escape (suboptimal) local minima while also performing implicit regularization.
To this purpose SIMPLIFIED DNNs will be DESIGNED and INFORMATION THEORY ideas will be exploited to shed new light on the compression properties of DNNs.

Dottorando: **Zhao Zhuan**
Supervisor: Prof. Maria Guglielmina Pelizzo
Argomento tesi:.

Dottorando: **Zugno Tommaso**
Supervisor: Prof. Michele Zorzi
Thesis main objectives: the next generation of cellular networks will support communications at mmWave frequencies, which have the potential to achieve extremely high throughput given the wide bandwidth availability in this portion of the spectrum. However, communications at such high frequencies are hampered by a number of problems that have to be overcome in order to fully exploit their potential, such as high pathloss, strong shadowing and blockage effects, and proper management of directional transmission and reception. My research project will focus on the characterization of the signal propagation at mmWave frequencies and on the study of new architectures and solutions to mitigate the aforementioned problems. The main objectives are:
Analysis of the existing mmWave channel models and design of new channel models for emerging use cases, such as vehicular and aerial scenarios

1. Design and evaluation of new resource scheduling and spectrum allocation algorithms
2. Design and evaluation of new architectures to improve the 5G access and core network
3. End-to-end performance evaluation of a realistic 5G-mmWave network in different scenarios and use cases