



Politecnico  
di Bari

**DEI** DIPARTIMENTO DI  
INGEGNERIA ELETTRICA  
E DELL'INFORMAZIONE

## DEI Doctoral Research Seminars

The Department of Ingegneria Elettrica e dell'Informazione of Politecnico di Bari (DEI) organizes a series of interdisciplinary research seminars to disseminate its doctoral activities. Doctoral students of the XXXV and XXXVI cycles of the two DEI PhD programs ([Industry 4.0](#) and [DRIEI](#)) will present their research activity both to fellow doctoral students and to Professors.

2 CFU will be recognized for PhD students of Politecnico di Bari attending at least 5 of the 6 meetings and 1 CFU will be recognized for the doctoral students who are speakers of a seminar.

The seminars will take place every Wednesday at 3 pm starting from February 2<sup>nd</sup>, 2022, and ending March 9<sup>th</sup>, 2022. Each speaker will be provided a 30-minute time slot for presentation and 10-minute time slot for discussion.

The seminars will be held virtually on MS Teams.

[To participate click here.](#)

02/02/2022

### **Paolo Scarabaggio**

#### **Nonconvex Game Theory**

In noncooperative games, a number of self-interested players with their own individual dynamics and constraints, aim at to optimizing their objective functions, possibly in competition with each other, e.g., due to the scarcity of shared resources. Natural frameworks to capture such a competitive decision-making process are suitably provided by the well-known game theory.

In this context, one of the most important solution concepts is the Nash equilibrium, which represents the common way to define the solution of a noncooperative game in many practical applications, from electricity markets to mobile-edge computing.

- Introduction to convex optimization and game theory.
- Preliminaries: monotone operators and variational inequality theory.
- Game theory on nonconvex sets.
- Motivating examples and analysis of case studies.

### **Lucilla Dammacco**

#### **Virtual Reality-based Design for Complex Manufacturing Systems**

Introduction: the role of Virtual Reality (VR) in Industry 4.0, and the digitalization in the industrial field with particular focus on complex manufacturing systems.

Analysis of the manufacturing system development process: focus on the engineering phase and integration of VR tools.

Definition of a VR supporting procedure: explanation of all the VR implementation phases (i.e., the steps from CAD to VR environment) throughout the entire system development process.

Real company use case: implementation of the proposed procedure in the design of an e-axle production line, highlighting the advantages achieved by the VR through an intuitive and immersive interaction (i.e., effective evaluation of the equipment layout, visibility, and ergonomics).

Discussion on the main findings and outcomes.

### **Gianvito Difilippo**

#### **Maximizing Convergence Speed for Second Order Consensus in Leaderless Multi-Agent Systems**

The presentation deals with the consensus problem in a leaderless network of agents that have to reach a common velocity while forming a uniformly spaced string. Moreover, the final common velocity (reference velocity) is determined by the agents in a distributed and leaderless way. Then, the consensus protocol parameters are optimized for networks characterized by a communication topology described by a class of directed graphs having a directed spanning tree, in order to maximize the convergence rate and avoid oscillations. The advantages of the optimized consensus protocol are enlightened by some simulation results and comparison with a protocol proposed in the related literature. The presented protocol can be applied to coordinate agents such as mobile robots, automated guided vehicles (AGVs) and autonomous vehicles that have to move with the same velocity and a common inter-space gap.

09/02/2022

### **Silvia Proia**

#### **Safe, Ergonomic, and Efficient Human-Robot Collaboration in Industry 4.0**

- Introduction: Role of “Collaborative Robotics” in Industry 4.0: main advantages in the manufacturing scenario, cobots vs robots.
- Control techniques for safe, ergonomic and efficient human-robot collaboration (HRC): review of the control techniques categorized by target (i.e., safety, ergonomics, and efficiency), by problem and type of control, in presence or absence of optimization.
- Trajectory planning: definition of the time-optimal trajectory planning problem along predetermined paths (objective function and kinematic/dynamic constraints) with the use of collaborative manipulators.
- Evaluation of the RULA index: definition of ergonomics in HRC, modeling of virtual mannequins, identification of the operator's workspace and of the geometric location of the points where RULA is minimal and so optimal.
- Evaluation of the thermal energy dissipated by the cobot along the planned trajectory.
- Discussion of the obtained results and open issues.

### **Gioacchino Tricarico**

#### **The Ancillary Service Markets (ASM): The Italian case**

In the last years the worldwide transmission system operators (TSOs) have to cope with the increasing of non-dispatchable generation capacity, ensuring the system operating security. The ancillary service market (ASM) aims at minimizing the costs to stockpile energy reserves from dispatchable generators in order to avoid any possible network contingency, power unbalance, branch congestion, etc., considering unit commitments (UCs) and interzonal network net transfer capacity. In the common market frameworks, the UC is included in the day ahead energy market, whereas in the Italian case it is embedded in the ASM increasing the complexity and the solving computational time of the model. Nevertheless, the optimization results must be feasible in relation to the network operating condition. This process is iterated until the ASM yields a secure operating point and satisfy the minimum reserves required.

### **Francesco De Nicolò**

#### **An Explainable framework for Tourism Intelligence: the Apulian case**

Tourism is a key economic sector and can play a major role for income, jobs and wealth creation. This is particularly true for the Italian region of Apulia witnessing in the last decade an increment of arrivals reaching the 70%. It will be shown how to exploit the informative content provided by reviews of Apulian facilities to identify, evaluate and explain which key elements drove this huge growth. In particular, an eXplainable Artificial Intelligence (XAI) framework is proposed that combines sentiment analysis and machine learning to accurately model and explain tourists' satisfaction. Explainability plays a central role in identifying which are the key concepts of positive or negative ratings, thus providing invaluable intelligence about the Apulian touristic attractiveness. The presented framework is general and can be easily adopted to characterize the touristic offers of any geographical region and the customer satisfaction.

# 16/02/2022

## Francesca Marasciuolo

### Integration of electric vehicles in DC microgrids and distribution network

- Introduction: Electric Vehicle Supply infrastructure (EVS) concept in the framework of DC microgrid; Vehicle-to-Grid (V2G) technology to support power regulation (national standards).
- The PROGRESSUS Project: goals, activities of Italian cluster, the EVS demonstrator.
- Operational planning of an EVS: day-ahead programming (problem formulation, constraints, performance analyses).
- Local Energy Community (LEC) concept: integration of multiple EVSs in a two-stage optimal energy management strategy (problem formulation, constraints, performance analyses).
- Discussion of results and open issues.

## Carmin Rodio

### Grid services to Transmission and Distribution System Operators through Distributed Energy Resources (DERs)

- DERs connected at medium/low voltage level to provide grid services for power system management and cooperation between Transmission and Distribution System operators in the employment of DERs as flexibility resources.
- Synthetic Inertia (SI) as grid service to provide dynamic frequency support.
- Application case: development of a low-cost controller able to measure the grid frequency and implement a SI control law on the management system of remotely controllable DERs.
- Discussion about obtained findings.

## Cosimo Iurlaro

### Studies to enable end-users to provide energy services to the power grid

The growing number of non-programmable renewable power plants, and the consequent reduction of fossil fuel power plants, is pushing the power grid to find new solutions to enable the power system to operate successfully. With the increase in small-scale distributed generation, end users could also provide support services to the power grid. This presentation will discuss some services that can be provided by end-users and the methods to provide them.

**23/02/2022****Laura Romeo****Perception devices and systems for monitoring humans and production process in Industry 4.0 scenarios"**

Nowadays, robotic systems have become a matter of considerable importance in many fields, such as healthcare, agriculture, surveillance, and manufacturing. With the advent of the fourth industrial revolution, also known as Industry 4.0, the number of robotic systems working with humans has occurred a further growth, mainly due to the ability of robots to simplify and speed up production, and to interact with operators. Nevertheless, human beings remain to play a key role in Industry 4.0 scenarios, thus it is fundamental to monitor human actions in all the most advanced domains, particularly in manufacturing. In this context, monitoring human movements using a vision system for the development of action recognition technology can be the key to provide information about the identification of both physical and cognitive behavior of the operator performing a task.

**Mattia Alessandro Ragolia****A virtual platform for real-time performance analysis of EM tracking systems for surgical navigation**

Electromagnetic Tracking Systems (EMTSs) are widely used in surgical navigation, allowing to improve the outcome of diagnosis and surgical interventions, by providing the surgeon with real-time position of surgical instruments during medical procedures. However, particular effort was dedicated to the development of efficient and robust algorithms, to obtain an accurate estimation of the instrument position for distances from the magnetic field generator beyond 0.5 m. Indeed, the main goal is to improve the limited range of current commercial systems, which strongly affects the freedom of movement of the medical team. Studies are currently being conducted to optimize the magnetic field generator configuration (both geometrical arrangements and electrical properties) since it affects tracking accuracy. In this research, we propose a virtual platform for assessing the performance of EMTSs for surgical navigation, providing real-time results and statistics, and allowing to track instruments both in real and simulated environments. Simulations and experimental tests are performed to validate the proposed virtual platform, by employing it to assess the performance of a real EMTS. The platform offers a real-time tool to analyze EMTS components and field generator configurations, for a deeper understanding of EMTS technology, thus supporting engineers during system design and characterization.

**Antonello Florio****Same power, longer range: estimating the Angle-of-Arrival for adaptive beamforming**

Most of the power required by IoT devices is employed in the radio section. The majority part of those devices has strong constraints on power consumption, and so they cannot perform complex computations in order to save resources for the other tasks. In this talk, I propose a possible solution to perform Angle-of-Arrival (AoA)-based location in the PHY layer of the networking stack, in order to lighten upper layers from this computational load and make the information available to the adaptive beamforming network. In this way, it is possible to steer the antenna radiation pattern towards a given direction, thus allowing to reduce the power needed to reach a given point in the space when compared to omnidirectional radiators and save precious power units without overloading the system.

02/03/2022

**Giulia Tresca**

### **Decision and control problems in logistics 4.0**

Distribution logistics is one of the four sub-sectors of logistics, that generates the highest percentage of the logistics operations costs. This mostly depends on the absence of a holistic approach to the resolution of the related decision problems. In this presentation, the principal decision problems, i.e., the Bin Packing Problem, the Container Loading Problem, and the Vehicle Routing Problem, are discussed, presenting practical resolution methods for real applications.

The contents of the discussion are as follows:

- Industry 4.0 and Logistic 4.0: a brief overview.
- Distribution logistics: connecting internal and external logistics and overview on the main challenges.
- The Bin Packing Problem, the Container Loading Problem, and the Vehicle routing problem: how we can use optimization problem in real-life scenarios.
- A realistic application: from the planning phase to real-time delivery.
- Discussion on the main findings and outcomes.

**Annamaria Demarinis**

### **Assessment of Italian Intellectual Property Data: A Machine Learning Approach**

In the multidisciplinary and complex context of Industry 4.0 the technology transfer plays a key role for the adsorption and dissemination of technologies, resources and knowledge in order to transform the invention into tangible and useful innovation. In the framework of technology transfer, the patent analytics represents an important tool for more effective exploitation of the largest repository of technological information. By applying NLP techniques and machine learning approach to the italian intellectual property data, it is possible to make an assessment of the technologies and knowledge, obtain an overview of the relevant trends and perform early identification of emerging technologies.

**Gaetano Volpe**

### **The role of blockchains and smart contracts in decentralized industrial environments**

The Blockchain is one of the last decade emerging technologies in software architectures. Its nature of a distributed ledger database allowing verifiable and tamper-proof transactions between untrusted parties makes it suitable for a vast class of domains concerning business processes.

In Cloud Manufacturing context, the number of applications is increasing and there are still currently open issues to be explored in terms of integrity, security and decentralization of business processes.

In this regard, it will be presented an architecture based on Ethereum Blockchain for improving digital processes in a manufacturing environment, based on Blockchain and Smart Contracts. Moreover, it will be shown how the integration of Blockchain with other existing cloud technologies, such as Docker and Kubernetes, improves service delivery and execution and enables the developing of a general framework for industrial environments.

Finally, some examples of intelligent control for task orchestration in a deep-learning and reinforcement learning fashion will be introduced to solve task-assignment problems in this context.

09/03/2022

**Alessio Pricci**

### **Analytical model of fused thermoplastic material extrusion**

Recent developments in Additive Manufacturing are moving towards a new trend in Material extrusion processes (ISO/ASTM 52910:2018), namely the possibility to print thermoplastic strands directly from pellet. A mathematical model concerning the analytical description of the behaviour of the system made up of a Single-screw Extruder (SSE), a coupling element and the extruding nozzle is presented. It allows to calculate the extruded mass flow rate, melting and pressure profile, for a given screw speed. Moreover, both an experimental setup, aiming at predicting the mass flow rate of a real SSE and Computational Fluid Dynamics (CFD) simulations are used with the purpose to validate the theory presented.

**Gianluca Minervini**

### **Carbon Dots: Low-Cost and Eco-Friendly Nanoparticles for Fabrication of Advanced Materials**

Carbon Dots (CDs) are carbon-based nanometric sized particles characterized by intense visible light fluorescence, biocompatibility, low toxicity and environmental impact. In this presentation, some wet chemical approaches to synthesize CDs will be described, starting from selected low-cost organic molecules, with particular attention to the optical properties of the obtained nanoparticles. Such CDs can find application in fabrication of advanced nanocomposites materials, by coupling with metallic nanoparticles or embedding them in polymeric matrixes.

**Carmen Perri**

### **Modeling and Control of a High Voltage Driving Circuit for Dielectric Elastomer Actuators**

Dielectric Elastomer (DE) represents a class of *Smart material* consisting of an elastomeric film compliant electrodes printed on both sides. Therefore, the behaviour of the DE is similar to a capacitor. DE is characterized by high deformation (>100%), high flexibility, light weight and low power consumption, which makes this material suitable for applications such as actuators, and self-sensing operations. Though, to active the DE, high voltage is needed. In this context, my Ph.D. work takes place. The aim is to replace the bulky, heavy, and expensive high voltage amplifiers with a compact, modular, light weight, and efficient high voltage electronics. First step in order to reach this goal, is to develop a mathematical model of the electronic. The key idea is based on reformulating in an average setting the switching dynamics of the electric network. Thereafter, an advance control algorithm is going to be developed and implemented on  $\mu$ -controller, which will be place on the same board of the high voltage electronic to ensure the modularity of the circuit.