IEEE

UNIVERSITÀ DEGLI STUDI FIRENZE | DINFO DIPARTIMENTO DI INGEGNERIA DELL'INFORMAZIONE

Da un secolo, oltre.

2024 IEEE INTERNATIONAL WORKSHOP ON

Metrology for Industry4.0 & IoT

FLORENCE, MAY 29-31, 2024

FINAL PROGRAM

ATHENA
BUSINESS AND TECHNOLOGY CONSULTING

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Welcome Message from the General Chairs

On behalf of the Organizing Committee, we wish to welcome you to the *2024 IEEE International Workshop on Metrology for Industry 4.0 and IoT*. It is a pleasure to have you here at this 7th edition of *IEEE MetroInd4.0&IoT* and we hope that the Workshop can be the starting point for fruitful collaborations between the participants.

This seventh edition is hosted in Florence, Italy. The organization is coordinated by University of Florence, University of Brescia, University Campus Bio-Medico di Roma, University of Trento, and Universitad Politecnica de Catalunia, together with the invaluable contribution of the University of Sannio.

This prestigious event gathers leading academics, industry experts, and practitioners from around the globe to discuss and advance the critical role of metrology in the rapidly evolving domains of Industry 4.0 and the Internet of Things (IoT).

Over the course of this workshop, we will delve into a comprehensive program featuring cutting-edge research, innovative methodologies, and practical applications that are shaping the future of industrial automation and smart manufacturing. Our agenda includes keynote speeches from renowned thought leaders, technical sessions covering a wide array of topics, interactive workshops, and panel discussions designed to foster deep engagement and collaboration.

Key themes of this year's conference encompass advancements in precision measurement technologies, the integration of cyber-physical systems, sensor networks, and the implementation of IoT in industrial processes. These sessions aim to provide insights into the latest trends, challenges, and solutions in metrology, emphasizing its significance in enhancing quality control, productivity, and efficiency in Industry 4.0 environments.

The received extended abstracts were submitted to a peer-review process. Relevance, quality, significance, and novelty of the scientific contribution were the main attributes for acceptance and publication in the Proceedings. The Proceedings are going to be submitted for publication in the IEEEXplore Digital Library. We would like to thank all the reviewers who actively contributed to the selection and quality improvement of the presented works.

MetroInd4.0&IoT 2024 is honoured to have experts in robotics and Industry 4.0 as Invited Speakers.

- Chi-Hung Hwang, from Taiwan Instrument Research Institute, Narlabs, Taiwan, will present the first day a speech entitled "Instrumentation and Engineering Platform for Supporting Academia on Developing Technologies for Industries 4.0 & IoT"
- Danilo Pau, STMicroelectronics, will present "Unified the AI tool stands: Introducing the ST Core AI Technology" on the second day.

- Marco Ribichini, Dewesoft, Italy, will give a talk on “Sensors and Data Acquisition Systems Available to Industry 4.0: An Application Case of how they are used to Automate a Production Line”, on the last day of the workshop.

We express our sincere gratitude to our distinguished speakers, sponsors, patronages, and the organizing committee, whose tireless efforts and support have made this event possible. We also encourage all attendees to actively participate in the discussions, visit the exhibition area to explore innovative products and solutions, and take advantage of the networking opportunities to build lasting professional relationships.

To recognize the most outstanding paper presented at the annual *2024 IEEE International Workshop on Metrology for Industry 4.0 and IoT*, the Best Conference Paper Award sponsored by Sensors Journal will be assigned. Other awards will be assigned to the Best Paper presented by a Young Researcher, and to the Best Paper Presented by a Woman, this last sponsored by IEEE Italy Section Affinity Group of Women in Engineering, to recognize the full engagement of women in all aspects of the Metrology in Industry 4.0 and IoT.

May your time at *IEEE MetroInd4.0&IoT 2024* be intellectually stimulating and professionally rewarding. We trust you will find the conference both inspiring and enriching, and we look forward to the contributions each of you will make to advance the field of metrology in Industry 4.0 and IoT.

The *2024 IEEE International Workshop on Metrology for Industry 4.0 and IoT* is about to begin. Metrologists, Industrial ICT engineers and IoT designers enjoy the Workshop!

May 2024

Marcantonio Catelani, University of Firenze, Italy
Lorenzo Ciani, University of Firenze, Italy
Pasquale Daponte, University of Sannio, Italy

MetroInd4.0&IoT 2024 General Chairs

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Mengchu Zhou, New Jersey Institute of Technology, USA
Krzysztof Kozłowski, Poznan University of Technology, Poland

IEEE MetroInd 2024 Keynote Speakers

Plenary Session - Wednesday May 29 - H 14:30

Instrumentation and Engineering Platform for Supporting Academia on Developing Technologies for Industries 4.0 & IoT

Chi-Hung **Hwang**

Taiwan Instrument Research Institute, NARLABS, Taiwan

ABSTRACT

Developing sensors, algorithms, and systems for Industry 4.0 and IoT applications poses significant challenges, especially for academic researchers with limited engineering resources. TIRI, a research institute of Taiwan's research funding agency, is dedicated to aiding the technological advancement of local industries and universities. Recognizing the need for a shared platform that provides engineering resources, prototype testing, data, and field tests is crucial; therefore, several projects to assist academics are executed to realize their novelty in developing new applications for Industry 4.0 and IoT. This presentation will illustrate examples from Taiwan, showing how a research institute supports academia in actualizing their innovative approaches, specifically designed to cater to the needs of Industry 4.0 and IoT sectors. We will introduce several case studies, emphasizing strategies to enhance research collaboration between academic and research institutions and the provision of tools to validate the performance of sensors developed in academia, ensuring the developed sensor systems can meet the standards of industrial applications.

SPEAKER BIOGRAPHY

Dr. **Chi-Hung Hwang**, a Research Fellow at the Taiwan Instrument Technology Institute of National Applied Research Laboratories, Taiwan, secured his Ph.D. in Power Mechanical Engineering from the esteemed National Tsing Hua University, Taiwan, in 1996. Upon completion of his doctoral studies, he embarked on his professional journey with the Precision Institution Development Center (now recognized as TIRI) of the National Science Council, initially as an Associate Researcher. He was promoted to Research Fellow in 2002 after involvement in a remote sensing system project and payload development program for a demonstrated CubeSat.

Dr. Hwang was deeply involved in PIDC's metamorphosis from a government subsidiary organization into a research-centric national laboratory. He led the planning division, focusing on PIDC's long-term planning. His research endeavors primarily encompass the application of optical methods across diverse fields, including mechanical materials determinations, Optomechatronics, vibration measurements, bio-medical instruments, and image-based measurements.

In the realm of service, Dr. Hwang has an impressive record, having served two consecutive terms as I&M AdCom from 2016 to 2023. His leadership portfolio is extensive, including roles such as Chair of TC-18 since 2019, VP of Conferences (2017-2018), member of the I2MTC Board of Directors (2015-2017), I2MTC Conference Chair (2016), TPC-co-chair (2018), and ATPCs (2021-). Presently, he holds the position of VP of Education for the IEEE I&M Society. In addition, he is the chair of the Optical Method Technical Division of the Society for Experimental Mechanics for the 2023-2024 term.

Plenary Session - Thursday May 30 - H 10:50

Unified the AI tool stands: Introducing the ST Core AI Technology

Danilo **Pau**
STMicroelectronics

ABSTRACT

Tiny Machine Learning engineers urge new tools to help them to be more productive than ever to develop innovative AI solutions at the edge. When devising applications for humanoid robotics, mobility, consumer, IoT, medical, industrial etc. any fragmentation in the workflow with respect to the underlying products to be adopted severely limit their creativity and capability to achieve fast deployment into the market.

The AI Unified Core Technology has been created as a common code generator across products to address this challenge and to act as the enabling unifying AI technology to serve many, even heterogeneous, product generations.

This technology interfaces the most widely used Deep Learning representations such as Keras, QKeras and Tensorflow Lite and the Open Neural Network Exchange (ONNX). It outputs optimized C code. Moreover, it makes available public APIs to deploy applications on STM32, Stellar MCUs and AI MEMs sensors thus easing developers workflow and to finalize their application of choice with unprecedented speed.

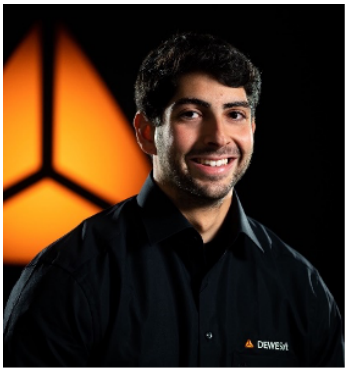
SPEAKER BIOGRAPHY

Danilo Pau (h-index 28, i10-index 73) graduate in 1992 at Politecnico di Milano, Italy. On 1991, he joined SGS-THOMSON (now STMicroelectronics) as interns on Advanced Multimedia Architectures, and he worked on memory reduced HDMAC HW design. Some exemplary project he worked on were: MPEG2 video memory reduction; video coding, transcoding, embedded (Khronos) 2/3D graphics, and (ISO CDVS and CDVA) computer vision. Currently, his work focuses on the ST unified AI core technology integrated into company tools (STM32Cube.AI, Stellar.AI, SPC-Studio.AI, MEMs Studio).
Danilo is an IEEE Fellow, 2019; AAIA Fellow on 2023; ST fellow on 2022 and APSIPA Life Member. In IEEE he is a Member of the Machine Learning, Deep Learning and AI in the CE (MDA) Technical Stream Committee CESoc. He wrote the IEEE Milestone on Multiple Silicon Technologies on a chip, 1985 which was ratified by IEEE BoD in 2021 and IEEE Milestone on MPEG Multimedia

Integrated Circuits, 1984-1993 which was ratified in 2022. He serves as TPC member to TinyML Symposium and Summit as well as Talks series and much more, and as 2022/3 IEEE Computer Society Fellow Evaluating Committee Members. With 81 and 68 respectively European and US application patents, 181 publications, 113 ISO/IEC/MPEG authored documents and 90 invited talks/seminars at various Universities and Conferences, Danilo's favorite activity remains supervising undergraduate students, MSc engineers and PhDs.

IEEE MetroInd 2024 Tutorial

Tutorial Session - Friday May 31 - H 09:30



Sensors and Data Acquisition Systems Available to Industry 4.0: An Application Case of how they are used to Automate a Production Line

Marco **Ribichini**
DEWESOFT

ABSTRACT

By utilizing a thermal imaging camera alongside a data acquisition system, this study focused on optimizing the chocolate spraying process in a prominent ice cream company and streamlining the production line of their products through automation. Through the analysis of collected data and comparison with predetermined benchmarks established during simulated defect scenarios in the production process, significant parameters were identified to form the basis for automated interventions. While emphasizing the necessity of a real time acquisition system for continuous monitoring and control, this research underscores the importance of maintaining optimal production efficiency. The outcomes from implementing algorithms via DewesoftX software enabled the monitoring of various digital outputs, thus facilitating automated rejection of non-conforming products. The ability to measure and contrast current ice cream metrics has enabled automated processes for swift identification and removal of substandard products through a specialised machine on the production line. The overarching goal of these technological advancements is to propel the company towards an Industry 4.0 framework, leveraging advanced sensors, software and robotics integrated into the operational infrastructure. These components facilitate data collection and analysis, fostering a more efficient decision-making and enabling improved automation, predictive maintenance, and self-optimization of production enhancement.

SPEAKER BIOGRAPHY

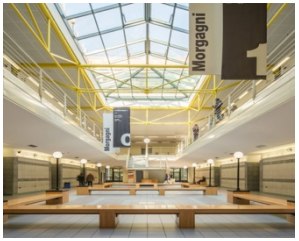
Marco Ribichini began his working career in the measurement world in 2023 when he joined the Dewesoft family. With a strong passion for management and sales, he decided to pursue a degree in Management Engineering at Sapienza University of Rome, graduating in 2022 with a

major in Economics and Management of Technology. After a year working as a project manager in the field of telecommunications, he transitioned to the innovative and dynamic world of measurement to expand his knowledge across various fields of application. His enduring passion for power and energy measurements remains strong. Currently, he serves as Sales and Technical Support Engineer at Dewesoft Italy in the Rome office.

IEEE MetroInd 2024 Venue

IEEE **MetroInd 2024** will be held at the **University of Florence - Centro Didattico Morgagni**.

Centro Didattico Morgagni of the University of Florence, close to the Careggi Hospital, is easily reachable by tramway both from the railway station and from the airport. Further information are reported in the section below.



ADDRESS
Viale Giovanni Battista Morgagni, 40
Firenze

Use the QRCode to open the location on *Google Maps*

Centro Didattico Morgagni (University of Florence) is located in Viale Morgagni n. 44 (main entrance). The tramline T1 (direction Careggi Ospedale, Morgagni Università stop) links Santa Maria Novella train station with the venue.

IEEE MetroInd 2024 Social Events

WELCOME PARTY
Wednesday May 29 - H 20:00

The Welcome Party will be held on **Wednesday, May 29 - 20.00** - at "Caffetteria delle Oblate". Once a monastery close to the Duomo, library and cafeteria on the first floor with a panoramic terrace. Offers presentations of books with famous guests, cocktails and dinners. A unique environment in a setting of extraordinary beauty.

caffetteria delle oblate

ADDRESS
Via dell'Oriuolo, 26
Firenze, Italy

SOCIAL DINNER
Thursday May 30 - H 20:00

The Gala Dinner will be held on **Thursday, May 30 - 20.00** - at **"Ristorante Santa Elisabetta" - Brunelleschi Hotel.** The restaurant is at the first floor of ***Hotel Brunelleschi***.

FINE DINING Santa Elisabetta BRUNELLESCHI HOTEL
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Piazza Sant'Elisabetta, 3
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Program Schedule - Wednesday, May 29

WEDNESDAY - MAY 29 2024			
09:30 - 10:00	OPENING CEREMONY		
	Room 014	Room 008	Room 327 (Third Floor)
10:00 - 11:20	Session 1.1 - Advancement in Sensors and Measurements for Health - PART I	Session 1.2 - The Role of AI, IoT, and Virtual Worlds in Shaping Modern Gaming Interaction and Immersivity for Humans	Session 1.3 - Sensors and Measurement Techniques for Food Quality and Safety in Industry 4.0 - PART I
11:20 - 11:40	COFFEE BREAK		
11:40 - 13:20	Session 2.1 - Positioning, Tracking and Navigation in the Industry 4.0 era	Session 2.2 - General Session - PART I	Session 2.3 - Sensors and Measurement Techniques for Food Quality and Safety in Industry 4.0 - PART II
13:20 - 14:30	LUNCH		
14:30 - 15:30	Keynote Session - Instrumentation and Engineering Platform for Supporting Academia on Developing Technologies for Industries 4.0 & IoT Chi-Hung Hwang, Taiwan Instrument Research Institute, NARLABS, Taiwan		
15:30 - 15:50	COFFEE BREAK		
	Room 014	Room 008	Room 327 (Third Floor)
15:50 - 17:50	Session 3.1 - Measurements and Virtual Measurements towards Industry 5.0: Approaches and Solutions for Smart Manufacturing	Session 3.2 - Current and emerging trends in (I)IoT wireless solutions	Session 3.3 - General Session - PART II
20:00	WELCOME PARTY		

Program Schedule - Thursday, May 30

THURSDAY - MAY 30 2024			
	Room 014	Room 008	Room 005
09:00 - 10:20	Session 4.1 - Unobtrusive Monitoring of Physiological Parameters and Human Activities: sensors, algorithms and applications - PART I	Session 4.2 - Advances in predictive maintenance and fault detection for Industry 4.0 - PART I	Session 4.3 - Telecommunications of the Future for Industrial Networks - PART I
10:20 - 10:50	COFFEE BREAK		
10.50 - 11:50	Keynote Session - Unified the AI tool stands: Introducing the ST Core AI Technology Danilo Pau, STMicroelectronics		
11:50 - 13:10	Session 5.1 - Unobtrusive Monitoring of Physiological Parameters and Human Activities: sensors, algorithms and applications - PART II	Session 5.2 - Advances in predictive maintenance and fault detection for Industry 4.0 - PART II	Session 5.3 - Telecommunications of the Future for Industrial Networks - PART II
13:10 - 14:30	LUNCH		
	Room 014	Room 008	
14:30 - 16:10	Session 6.1 - Wearable Sensors and New Frontiers for Human Health Monitoring	Session 6.2 - Scalable Solutions for Early Detection of Neurological and Psychiatric Disorders	
16:10 - 16:30	COFFEE BREAK		
16:30 - 17:50	Session 7.1 - Cybersecurity Standards and Technologies for IoT and Industry 4.0 (SecurityStandards)	Session 7.2 - Metrology for Zero-Defect Manufacturing	
20:00	GALA DINNER		

Program Schedule - Friday, May 31

FRIDAY - MAY 31 2024		
09:30 - 10:30	Tutorial Session - Sensors and Data Acquisition Systems Available to Industry 4.0: An Application Case of how they are used to Automate a Production Line Marco Ribichini, DEWESOFT	
10:30 - 10:50	COFFEE BREAK	
	Room 014	Room 008
10:50 - 12:50	Session 8.1 - Sensors for Medical Applications	Session 8.2 - Advancement in Sensors and Measurements for Health - PART II
12:50 - 14:00	LUNCH	
	Room 014	Room 008
14:00 - 16:00	Session 9.1 - Industry 4.0: Productivity, Sustainability and Enabling Technologies in the Framework of the PNRR and other founded projects	Session 9.2 - Measurement tools and emerging approaches for human motion analysis
16:00 - 16:20	COFFEE BREAK	
16:20 - 16:50	CLOSING AND AWARD CEREMONY	

Technical Program - Wednesday, May 29

08:30 - 18:00 *University of Florence - Centro Didattico Morgagni*
REGISTRATIONS

09:30 - 10:00 *Room 014 - Centro Didattico Morgagni*
OPENING CEREMONY

Welcome Addresses

Technical Program Overview

MICS - Made in Italy Circolare e Sostenibile: An Industry and University partnership to promote research and innovation
Emilio Sardini, University of Brescia, Italy

10:00 - 11:20 *Room 014 - Centro Didattico Morgagni*
Session 1.1 - Advancement in Sensors and Measurements for Health - PART I
Chair: Mauro Serpelloni, *University of Brescia, Italy*

10:00 **Preliminary Study on Printed Membrane by Aerosol Jet for Ion Detection in Industrial Field**
Giorgia Polidori, University of Brescia, Italy
Sarah Tonello, University of Padova, Italy
Mauro Serpelloni, University of Brescia, Italy
Marta Giamberini, Universitat Rovira i Virgili, Spain
Xavier Montané, Universitat Rovira i Virgili, Spain
José Antonio Reina, Universitat Rovira i Virgili, Spain

10:20 **A Novel 3D Printed Sensorized Surgical Instrument to Characterize Pituitary Adenoma: Development and Initial Validation**
Giacomo Santona, University of Brescia, Italy
Antonio Fiorentino, University of Brescia, Italy
Francesco Doglietto, Fondazione Policlinico Universitario A. Gemelli, Italy
Mauro Serpelloni, University of Brescia, Italy

10:40 **Transit Time Measurement Method by Complex Cross-Spectrum Analysis Applied to a Variable PWV Arterial Simulator**
Federico Filippi, Roma Tre University, Italy
Giorgia Fiori, Roma Tre University, Italy
Silvia Conforto, Roma Tre University, Italy
Andrea Scorza, Roma Tre University, Italy
Salvatore Andrea Sciuto, Roma Tre University, Italy

11:00 **First Development of a LMHF Vibration System for Cell Incubators**
Marta Cecchitelli, Roma Tre University, Italy
Federico Filippi, Roma Tre University, Italy
Giorgia Fiori, Roma Tre University, Italy
Jan Galo, IRCCS Children Hospital Bambino Gesù, Italy
Andrea Del Fattore, IRCCS Children Hospital Bambino Gesù, Italy
Aurelio Secinaro, IRCCS Children Hospital Bambino Gesù, Italy
Salvatore Andrea Sciuto, Roma Tre University, Italy
Andrea Scorza, Roma Tre University, Italy

10:00 - 11:00 *Room 008 - Centro Didattico Morgagni*
Session 1.2 - The Role of AI, IoT, and Virtual Worlds in Shaping Modern Gaming Interaction and Immersivity for Humans
Chair: Antonio Lanatà, *University of Florence, Italy*

10:00 **Prompt Evolution Through Examples for Large Language Models-A Case Study in Game Comment Toxicity Classification**
Pittawat Taveekitworachai, Ritsumeikan University, Japan
Febri Abdullah, Ritsumeikan University, Japan
Mustafa Can Gursesli, University of Florence, Italy
Antonio Lanatà, University of Florence, Italy
Andrea Guazzini, University of Florence, Italy
Ruck Thawonmas, Ritsumeikan University, Japan

10:20 **Finger-Mounted Tactile Display of Softness for Virtual Reality**
Gabriele Frediani, University of Florence, Italy
Federico Carpi, University of Florence, Italy

10:40 **Markov Chain Modeling of Facial Emotions' Dynamics in Video Games**
Pietro Tarchi, University of Florence, Italy
Mustafa Can Gursesli, University of Florence, Italy
Federico Calà, University of Florence, Italy
Lorenzo Frassineti, University of Florence, Italy
Andrea Guazzini, University of Florence, Italy
Antonio Lanatà, University of Florence, Italy

10:00 - 11:20 *Room 327 (Third Floor) - Centro Didattico Morgagni*
Session 1.3 - Sensors and Measurement Techniques for Food Quality and Safety in Industry 4.0 - PART I
Chair: Valentina Bianchi, *University of Parma, Italy*

10:00 **Securing Origin Integrity Through Machine Learning Analysis of Mozzarella di Bufala PDO Microbiome**
Michele Magarelli, Università Degli Studi di Bari Aldo Moro, Italy
Pierpaolo Di Bitonto, Università Degli Studi di Bari Aldo Moro, Italy
Francesca De Filippis, Università degli Studi di Napoli Federico II, Italy
Pierfrancesco Novielli, Università Degli Studi di Bari Aldo Moro, INFN-BA, Italy
Raffaele Magliulo, Università degli Studi di Napoli Federico II, Italy
Domenico Diacono, Istituto Nazionale di Fisica Nucleare Sezione di Bari, Italy

Roberto Bellotti, Università Degli Studi di Bari Aldo Moro, INFN-BA, Italy
Sabina Tangaro, Università Degli Studi di Bari Aldo Moro, INFN-BA, Italy

10:20 **Model-Based Design of a Machine Learning Algorithm for On-Site Food Authenticity Testing**
Mattia Stighezza, University of Parma, Italy
Giulia Magnani, University of Parma, Italy
Valentina Bianchi, University of Parma, Italy
Stefano Cagnoni, University of Parma, Italy
Andrea Boni, University of Parma, Italy
Chiara Giliberti, University of Parma, Italy
Davide Errico, University of Parma, Italy
Simone Fortunati, University of Parma, Italy
Marco Giannetto, University of Parma, Italy
Maria Careri, University of Parma, Italy
Ilaria De Munari, University of Parma, Italy

10:40 **AI Solutions for Grilled Eggplants Sorting: A Comparative Analysis of Image-Based Techniques**
Paolo Brambilla, Politecnico di Milano, Italy
Emanuele Locatelli, Politecnico di Milano, Italy
Davide Mondin, Politecnico di Milano, Italy
Chiara Conese, Politecnico di Milano, Italy
Remo Sala, Politecnico di Milano, Italy
Marco Tarabini, Politecnico di Milano, Italy

11:00 **A Prototype of a Water Quality Management System for Smart Aquaculture Using Solar System to Support Fish Farmer, Phragnamdang, Amphawa, Samut Songkhram Province**
Pijitra Jomsri, Suan Sunandha Rajabhat University, Thailand
Dulyawit Prangchumpol, Suan Sunandha Rajabhat University, Thailand

11:20 - 11:40 *University of Florence - Centro Didattico Morgagni*
COFFEE BREAK

11:40 - 13:20 *Room 014 - Centro Didattico Morgagni*
Session 2.1 - Positioning, Tracking and Navigation in the Industry 4.0 era
Chairs: Alice Buffi, *University of Pisa, Italy*
Daniele Fontanelli, *University of Trento, Italy*
Luca Santoro, *University of Trento, Italy*

11:40 **An Experimental Assessment of 5G Uplink Ranging**
Pietro Morri, Politecnico di Milano, Italy
Viola Bernazzoli, Politecnico di Milano, Italy
Mattia Brambilla, Politecnico di Milano, Italy
Eugenio Moro, Politecnico di Milano, Italy
Ilario Filippini, Politecnico di Milano, Italy
Monica Nicoli, Politecnico di Milano, Italy

12:00 **Propagation of Measurement Uncertainty in IMU Orientation Tracking Algorithms**
Daniele Buonocore, University of Salerno, Italy
Marco Carratù, University of Salerno, Italy
Vincenzo Gallo, University of Salerno, Italy
Valter Laino, University of Salerno, Italy
Antonio Pietrosanto, University of Salerno, Italy
Paolo Sommella, University of Salerno, Italy

12:20 **UHF RFID Positioning With Square Antenna Trajectory**
Gabriele Bandini, University of Pisa, Italy
Mirko Marracci, University of Pisa, Italy
Bernardo Tellini, University of Pisa, Italy
Alice Buffi, University of Pisa, Italy

12:40 **Unveiling the Undersea: A Collaborative Approach to Monitoring Underwater Objects**
Luca Santoro, University of Trento, Italy
Davide Brunelli, University of Trento, Italy
Daniele Fontanelli, University of Trento, Italy

13:00 **Underwater Localization Using SAR Satellite Data**
Aminu Muhammad, Robert Gordon University, United Kingdom
Nazila Fough, Robert Gordon University, United Kingdom
Somasundar Kannan, Robert Gordon University, United Kingdom
Mozhgan Zahriban Hesari, Parthenope University of Naples, Italy

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11:40 - 13:20 *Room 008 - Centro Didattico Morgagni*
Session 2.2 - General Session - PART I
Chair: Gabriele Patrizi, *University of Florence, Italy*

11:40 **The Impact of Electrical Signature Quality in NILM Process: A Preliminary Analysis Based on Unsupervised Approch**
Luca Tari, University of Cassino and Southern Lazio, Italy
Antonio Nardone, University of Cassino and Southern Lazio, Italy
Luigi Ferrigno, University of Cassino and Southern Lazio, Italy
Antonello Monti, RWTH Aachen University, Germany
Ferdinanda Ponci, RWTH Aachen University, Germany

12:00 **An Internet of Things-Based Solution for Monitoring Freight Train Carriages**
Rosario Schiano Lo Moriello, University of Naples Federico II, Italy
Enzo Caputo, University of Naples Federico II, Italy
Federico Gargiulo, University of Naples Federico II, Italy
Giorgio de Alteriis, University of Naples Federico II, Italy
Angelo Donvito, Digimat S.p.A., Italy
Paolo Bitonto, Digimat S.p.A., Italy
Alfredo Alfano, Conexo Srl, Italy

12:20 **Acoustic Communication on Metallic Structures: Implementation and Results**
Paolo Caruso, University of Salerno, Italy
Vincenzo Paciello, University of Salerno, Italy
Jose A. Salvado, University of Beira Interior, Portugal

Helbert da Rocha, University of Beira Interior, Portugal
António Espírito Santo, University of Beira Interior, Portugal

12:40 **A Multifaceted Approach to Grasping Force Estimation of CSFH-Based Electrostatic Microgrippers**
Gabriele Bocchetta, Roma Tre University, Italy
Giorgia Fiori, Roma Tre University, Italy
Salvatore Andrea Sciuto, Roma Tre University, Italy
Antonio Caputo, Roma Tre University, Italy
Andrea Scorza, Roma Tre University, Italy

13:00 **Optimizing Texture Representation in 3D Medical Models Using an RGBD Camera**
Cosimo Aliani, University of Florence, Italy
Leonardo Bocchi, University of Florence, Italy

11:40 - 13:20 *Room 327 (Third Floor) - Centro Didattico Morgagni*
Session 2.3 - Sensors and Measurement Techniques for Food Quality and Safety in Industry 4.0 - PART II
Chair: Valentina Bianchi, *University of Parma, Italy*

11:40 **METROFOOD-IT: A Data Platform Proposal Using Agrifood Smart Data Model**
Pierpaolo Di Bitonto, Università Degli Studi di Bari Aldo Moro, Italy
Domenico Diacono, Istituto Nazionale di Fisica Nucleare Sezione di Bari, Italy
Michele Magarelli, Università Degli Studi di Bari Aldo Moro, Italy
Sabina Tangaro, Università Degli Studi di Bari Aldo Moro, INFN, Italy
Roberto Bellotti, Università Degli Studi di Bari Aldo Moro, INFN, Italy
Donato Romano, Università Degli Studi di Bari Aldo Moro, Italy
Pierfrancesco Novielli, Università Degli Studi di Bari Aldo Moro, INFN, Italy
Claudia Zoani, ENEA, Italy
Donato Romano, Università Degli Studi di Bari Aldo Moro, INFN, Italy

12:00 **A IoT-Based System for Water Parameters Monitoring. Case Study: Fish Farming in El Salvador**
Omar Otoniel Flores-Cortez, Universidad Tecnologica de El Salvador, El Salvador
Ana Cecilia Flores Portillo, Centro de Desarrollo de La Pesca, El Salvador
Jose Mauricio Castro Elizondo, Ministerio de Educación, Ciencia y Tecnología, El Salvador
Fernando Arevalo, Ruhr-Universität Bochum, Germany
Carlos Pocasangre Jimenez, Universidad de El Salvador, El Salvador

12:20 **Hyperspectral Imaging and Machine Learning Techniques for the Automatic Sorting of Horticultural Products**
Eduardo Minieri, Politecnico di Milano, Italy
Edoardo Milani, Politecnico di Milano, Italy
Paolo Brambilla, Politecnico di Milano, Italy
Remo Sala, Politecnico di Milano, Italy
Marco Tarabini, Politecnico di Milano, Italy

12:40 **Capacitive Sensor to Estimate Plant Protection Products Sprayed in Precision Agriculture Applications**
Gemma Hornero, Universitat Politècnica de Catalunya, Spain

Jordi Llop-casamada, Universitat Politècnica de Catalunya, Spain
Oscar Casas, Universitat Politècnica de Catalunya, Spain

13:00 **Revolutionizing Agri-Food Sustainability: An Overview and Future Outlook Integrating IoT, DLT, and Machine Learning for Enhanced Farming Practices**
Remo Pareschi, University of Molise, Italy
Valentina Piantadosi, University of Molise, Italy
Sandro Pullo, University of Molise, Italy
Francesco Salzano, University of Molise, Italy

13:20 - 14:30	*University of Florence - Centro Didattico Morgagni* **LUNCH**

14:30 - 15:30	*Room 014 - Centro Didattico Morgagni* **PLENARY SESSION - KEYNOTE SPEAKER** **Chair**: Lorenzo Ciani, *University of Florence, Italy*

Instrumentation and Engineering Platform for Supporting Academia on Developing Technologies for Industries 4.0 & IoT

Chi-Hung Hwang, *Taiwan Instrument Research Institute, NARLABS, Taiwan*

15:30 - 15:50	*University of Florence - Centro Didattico Morgagni* **COFFEE BREAK**

15:50 - 17:50	*Room 014 - Centro Didattico Morgagni* **Session 3.1 - Measurements and Virtual Measurements towards Industry 5.0: Approaches and Solutions for Smart Manufacturing** **Chairs:** Giulio D'Emilia, *University of L'Aquila, Italy* Antonella Gaspari, *Politecnico di Bari, Italy*

15:50 **Comparison Between References in a Rotating Calibration Bench for Accelerometers**
Luciano Chiominto, University of L'Aquila, Italy
Giulio D'Emilia, University of L'Aquila, Italy
Emanuela Natale, University of L'Aquila, Italy
Andrea Prato, INRiM - National Institute of Metrological Research, Italy
Alessandro Schiavi, INRiM - National Institute of Metrological Research, Italy

16:10 **AI-Aided Thermal Imaging With Multispectral Camera for Direct Energy Deposition**
Vittorio Sala, SUPSI, Switzerland
Ambra Vandone, SUPSI, Switzerland
Michele Banfi, SUPSI, Switzerland
Federico Mazzucato, SUPSI, Switzerland
Stefano Baraldo, SUPSI, Switzerland
Anna Valente, SUPSI, Switzerland

16:30 **Investigation on the Aspects Influencing the Accuracy of a Simple and Affordable Image-Based System for Liquid Thin Films Monitoring**
Andrea Nono Dachille, Politecnico di Bari, Italy
Antonella Gaspari, Politecnico di Bari, Italy
Laura Fabbiano, Politecnico di Bari, Italy

16:50 **Power Quality Meter Based on Low-Cost Smart Platform**
Alessandro Bartolini, University of Florence, Italy
Marcantonio Catelani, University of Florence, Italy
Lorenzo Ciani, University of Florence, Italy
Francesco Grasso, University of Florence, Italy
Libero Paolucci, University of Florence, Italy
Gabriele Patrizi, University of Florence, Italy

17:10 **Implementation of a Dynamically Customizable, Resilient and Platform Independent Digital Twin to Enable Data Exchange Between Process Simulation and Measuring Systems**
Sven Schiffner, Fraunhofer Institute for Factory Operation and Automation IFF, Germany
Mathias Vorbröcker, Fraunhofer Institute for Factory Operation and Automation IFF, Germany

17:30 **Advancing Urban Waste Management Using Industry 5.0 Principles: A Novel Smart Bin**
Panagiotis Zoumpoulis, National Technical University of Athens, Greece
Fotios K. Konstantinidis, National Technical University of Athens, Greece
Georgios Tsimiklis, National Technical University of Athens, Greece
Angelos Amditis, National Technical University of Athens, Greece

15:50 - 17:50 *Room 008 - Centro Didattico Morgagni*
Session 3.2 - Current and emerging trends in (I)IoT wireless solutions
Chairs: Paolo Ferrari, *University of Brescia, Italy*
Ivanovitch Silva, *Federal University of Rio Grande do Norte, Brazil*

15:50 **Anomaly Detection in Industrial Networks Using Distributed Observation of Statistical Behavior**
Paolo Ferrari, University of Brescia, Italy
Paolo Bellagente, University of Brescia, Italy
Alessandra Flammini, University of Brescia, Italy
Massimiliano Gaffurini, University of Brescia, Italy
Stefano Rinaldi, University of Brescia, Italy
Emiliano Sisinni, University of Brescia, Italy
Dennis Brandão, University of Brescia, Italy

16:10 **Cost-Efficient Hardware and Synchronization for TDoA Localization Base Stations**
Christoph Hufnagl, TU Wien, Austria
Holger Arthaber, TU Wien, Austria

16:30 **Leveraging Graph-Based Leak Localization in Water Distribution Networks**
Rodrigo Rolle, São Paulo State University, Brazil
Weliton C Rodrigues, São Paulo State University, Brazil
Eduardo P Godoy, São Paulo State University, Brazil

Lucas Tomazini, São Paulo State University, Brazil
Lucas Monteiro, São Paulo State University, Brazil

16:50 **Proposal of a Microservice Plug-And-Produce Architecture for Industry 4.0**
Ricardo Pontarolli, São Paulo State University, Brazil
Eduardo A. Viana, São Paulo State University, Brazil
Roger T. Giglio, São Paulo State University, Brazil
Emiliano Sisinni, University of Brescia, Italy
Paolo Ferrari, University of Brescia, Italy
Eduardo P Godoy, São Paulo State University, Brazil

17:10 **Optimizing Vehicle IoT Systems: SUMO-Digital Twin Performance Analysis**
Mariana Azevedo, UFRN, Brazil
Matheus Andrade, UFRN, Brazil
Morsinaldo Medeiros, UFRN, Brazil
Thaís Medeiros, Federal University of Rio Grande do Norte, Brazil
Marianne Silva, Federal University of Alagoas, Brazil
Ivanovitch Silva, Federal University of Rio Grande do Norte, Brazil
Emiliano Sisinni, University of Brescia, Italy
Paolo Ferrari, University of Brescia, Italy

17:30 **Suitability of LoRaWAN and solar harvesting in IoT-ready fall detection solutions for light mobility**
Salvatore Dello Iacono, University of Brescia, Italy
Davide Astolfi, University of Brescia, Italy
Alessandro Depari, University of Brescia, Italy
Paolo Ferrari, University of Brescia, Italy
Alessandra Flammini, University of Brescia, Italy
Massimiliano Gaffurini, University of Brescia, Italy
Marco Pasetti, University of Brescia, Italy
Emiliano Sisinni, University of Brescia, Italy

15:50 - 17:50 *Room 327 (Third Floor) - Centro Didattico Morgagni*
Session 3.3 - General Session - PART II
Chair: Mauro Serpelloni, *University of Brescia, Italy*

15:50 **Multi-Parameter Estimation by Combining Dimensional Analysis and Eddy Current Testing**
Alessandro Sardellitti, University of Cassino and Southern Lazio, Italy
Vincenzo Mottola, University of Cassino and Southern Lazio, Italy
Filippo Milano, University of Cassino and Southern Lazio, Italy
Luigi Ferrigno, University of Cassino and Southern Lazio, Italy
Antonello Tamburrino, University of Cassino and Southern Lazio, Italy
Marco Laracca, Sapienza University of Rome, Italy

16:10 **Developing Smart Indoor Air Quality for Notifying of PM2.5 via Mobile and Supporting Solar Power System**
Dulyawit Prangchumpol, Rajabhat Suan Sunandha University, Thailand

16:30 **Design and Power Consumption Analysis of a Smart Hood to Reduce Indoor Air Pollution**
Gianluca Ciattaglia, Polytechnic University of Marche, Italy
Ennio Gambi, Polytechnic University of Marche, Italy
Grazia Iadarola, Polytechnic University of Marche, Italy
Susanna Spinsante, Polytechnic University of Marche, Italy

16:50 **Motorcycle Autonomous Emergency Steering (MAES): Empirical Riding Data Analysis for Actuation Selection and Bench Test Protocol Development**
Dario Cinelli, University of Florence, Italy
Cosimo Lucci, University of Florence, Italy
Lorenzo Berzi, University of Florence, Italy
Giovanni Savino, University of Florence, Italy

17:10 **Front-End Design in SiGe BiCMOS Technology for V-Band High Resolution Imaging**
Leonardo Tesi, Microtest, Italy
Giovanni Collodi, University of Florence, Italy
Alessandro Cidronali, University of Florence, Italy

17:30 **Sensitivity Analysis of PV Produced Power in Presence of Measurement Uncertainty**
Matteo Intravaia, University of Florence, Italy
Lorenzo Becchi, University of Florence, Italy
Marco Bindi, University of Florence, Italy
Luigi Costanzo, Università degli Studi della Campania Luigi Vanvitelli, Italy
Cristian Garzon Alfonso, University of Florence, Italy
Vipinkumar Shriram Meshram, Università degli Studi della Campania Luigi Vanvitelli, Italy
Alberto Reatti, University of Florence, Italy
Massimo Vitelli, Università degli Studi della Campania Luigi Vanvitelli, Italy

20:00 - 22:00	*Caffetteria delle Oblate* **WELCOME PARTY**

Technical Program - Thursday, May 30

09:00 - 10:20 *Room 014 - Centro Didattico Morgagni*

Session 4.1 - Unobtrusive Monitoring of Physiological Parameters and Human Activities: sensors, algorithms and applications - PART I

Chairs: Carlo Massaroni, *Università Campus Bio-Medico di Roma, Italy*
Ahmed Rasheed, *University of Bozen-Bolzano, Italy*

09:00 **Soft Force Sensor for Breathing Monitoring: Design, Development and Feasibility Assessment**
Chiara Romano, Università Campus Bio-Medico di Roma, Italy
Sergio Silvestri, Università Campus Bio-Medico di Roma, Italy
Daniela Lo Presti, Università Campus Bio-Medico di Roma, Italy
Emiliano Schena, Università Campus Bio-Medico di Roma, Italy
Carlo Massaroni, Università Campus Bio-Medico di Roma, Italy

09:20 **Indirect Respiratory Monitoring via Single-Lead Wearable ECG: Influence of Motion Artifacts and Devices on Respiratory Rate Estimations**
Carlo Massaroni, Università Campus Bio-Medico di Roma, Italy
Elzbieta Olejarczyk, AGH University of Krakow, Poland
Daniela Lo Presti, Università Campus Bio-Medico di Roma, Italy
Emiliano Schena, Università Campus Bio-Medico di Roma, Italy
Annunziata Nusca, Fondazione Policlinico Campus Bio-Medico, Italy
Gian Paolo Ussia, Fondazione Policlinico Campus Bio-Medico, Italy
Sergio Silvestri, Università Campus Bio-Medico di Roma, Italy

09:40 **Mechanical Coupling Between Body and Bed for Estimating Sleep-Related Biomarkers: A Feasibility Study**
Carlo Massaroni, Università Campus Bio-Medico di Roma, Italy
Francesca De Tommasi, Università Campus Bio-Medico di Roma, Italy
Daniela Lo Presti, Università Campus Bio-Medico di Roma, Italy
Manish Sharma, Institute of Infrastructure Technology Research and Management, India
Sergio Silvestri, Università Campus Bio-Medico di Roma, Italy
Emiliano Schena, Università Campus Bio-Medico di Roma, Italy

10:00 **Automatic Identification of Movement and Muscle Artifacts in ECG Based on Statistical and Nonlinear Measures**
Elzbieta Olejarczyk, AGH University of Krakow, Poland
Elzbieta Raus-Jarzabek, AGH University of Krakow, Poland
Carlo Massaroni, Università Campus Bio-Medico di Roma, Italy

09:00 - 10:20 *Room 008 - Centro Didattico Morgagni*

Session 4.2 - Advances in predictive maintenance and fault detection for Industry 4.0 - PART I

Chairs: Lorenzo Ciani, *University of Florence, Italy*
Gabriele Patrizi, *University of Florence, Italy*

09:00 **A Convolutional Neural Network to Locate Unbalance in Turbomachinery Supported by AMBs**
Giovanni Donati and MIchele Basso, University of Florence, Italy
Marco Mugnaini, University of Florence, Italy
Chiara Camerota, University of Florence, Italy

09:20 **Scrap Monitoring in Aluminum Melting Furnace Using Computer Vision and Deep Learning**
Yuvan Sathya Ravi, Politecnico di Milano, Italy
Stefano Marelli, One-Off Innovation, Italy
Paolo Chiariotti, Politecnico di Milano, Italy
Maurizio Colombo, One-Off Innovation, Italy
Marco Tarabini, Politecnico di Milano, Italy

09:40 **Introduction to Clustering Unsupervised Machine Learning Algorithms Applied to Power Quality Disturbances**
Marcantonio Catelani, University of Florence, Italy
Lorenzo Ciani, University of Florence, Italy
Cristian Garzon Alfonso, University of Florence, Italy
Francesco Grasso, University of Florence, Italy
Libero Paolucci, University of Florence, Italy
Gabriele Patrizi, University of Florence, Italy

10:00 **TEEMSC - Trainable Energy Efficient Machine Diagnosis Using Singular Values and Canonical Crosscorrelation**
Rick Pandey, Institute of Microelectronic and Mechatronic Systems, Germany
Sebastian Uziel, Institute of Microelectronic and Mechatronic Systems, Germany
Tino Hutschenreuther, Institute of Microelectronic and Mechatronic Systems, Germany
Silvia Krug, Mid Sweden University, Sweden, IMMS GmbH, Germany

09:00 - 10:20 *Room 005 - Centro Didattico Morgagni*
Session 4.3 - Telecommunications of the Future for Industrial Networks - PART I
Chair: Lorenzo Mucchi, *University of Florence, Italy*

09:00 **Life Cycle Analysis of Lithium Batteries for Smart Grids Using Electrochemical Impedance Spectroscopy Data**
Gabriele Patrizi, University of Florence, Italy
Fabio Canzanella, University of Florence, Italy
Lorenzo Ciani, University of Florence, Italy
Marcantonio Catelani, University of Florence, Italy

09:20 **Physical Layer Security at THz Communications: The Effects of Phase and Molecular Noise**
Stefano Caputo, University of Florence, Italy
Giacomo Borghini, University of Florence, Italy
Gianni Pasolini, University of Bologna, Italy
Nicolò Longhi, University of Bologna, Italy
Giampaolo Cuozzo, CNIT, WiLab, Italy
Lorenzo Mucchi, University of Florence, Italy

09:40 **Adaptive Security in Mobile Wireless Networks: Machine Learning-Enhanced Continuous Physical Layer Authentication for Dynamic Environments**
Dania Marabissi, University of Florence, Italy
Andrea Stomaci, University of Florence, Italy
Lorenzo Mucchi, University of Florence, Italy

10:00 **5G RAN and MEC Slices Management Framework for Networks of Industrial Things**
Francesco Chiti, University of Florence, Italy
Simone Morosi, University of Florence, CNIT, Italy
Claudio Bartoli, University of Florence, Italy

10:20 - 10:50 *University of Florence - Centro Didattico Morgagni*
COFFEE BREAK

10:50 - 11:50 *Room 014 - Centro Didattico Morgagni*
PLENARY SESSION - KEYNOTE SPEAKER
Chair: Mauro Serpelloni, *University of Brescia, Italy*

Unified the AI tool stands: Introducing the ST Core AI Technology

Danilo Pau, *STMicroelectronics*

11:50 - 13:10 *Room 014 - Centro Didattico Morgagni*
Session 5.1 - Unobtrusive Monitoring of Physiological Parameters and Human Activities: sensors, algorithms and applications - PART II
Chairs: Carlo Massaroni, *Università Campus Bio-Medico di Roma, Italy*
Ahmed Rasheed, *University of Bozen-Bolzano, Italy*

11:50 **Sleeping Posture Classification Through a Multi-Sensing Smart Mattress Based on Fiber Bragg Grating Sensors: A Feasibility Study**
Federico D'Antoni, Fondazione Policlinico Universitario Campus Bio-Medico di Roma, Italy
Francesca De Tommasi, Università Campus Bio-Medico di Roma, Italy
Giampiero Bartolomei, Università Campus Bio-Medico di Roma, Italy
Daniela Lo Presti, Università Campus Bio-Medico di Roma, Italy
Luca Vollero, Università Campus Bio-Medico di Roma, Italy
Sergio Silvestri, Università Campus Bio-Medico di Roma, Italy
Emiliano Schena, Università Campus Bio-Medico di Roma, Italy
Mario Merone, Università Campus Bio-Medico di Roma, Italy
Carlo Massaroni, Università Campus Bio-Medico di Roma, Italy

12:10 **The QRS Detection Using the Modified Pan-Tompkins Algorithm**
Mohammed Owahidur Rahman, AGH University of Krakow, Poland
Piotr Augustyniak, AGH University of Krakow, Poland
Elzbieta Olejarczyk, AGH University of Krakow, Poland

12:30 **Improving Kinematic Measurements in Indoor Sport Applications Through EKF-Based UWB/IMU Fusion**
Antonio Delle Femine, University of Campania Luigi Vanvitelli, Italy

Daniele Gallo, University of Campania Luigi Vanvitelli, Italy
Claudio Iodice, University of Campania Luigi Vanvitelli, Italy
Carmine Landi, University of Campania Luigi Vanvitelli, Italy
Mario Luiso, University of Campania Luigi Vanvitelli, Italy

12:50 **Measuring Behaviour of People With Dementia Using a Non-Invasive Sensor Network**
Nicole Morresi, Università Politecnica delle Marche, Italy
Sara Casaccia, Università Politecnica delle Marche, Italy

11:50 - 13:10 *Room 008 - Centro Didattico Morgagni*
Session 5.2 - Advances in predictive maintenance and fault detection for Industry 4.0 - PART II
Chairs: Lorenzo Ciani, *University of Florence, Italy*
Gabriele Patrizi, *University of Florence, Italy*

11:50 **Lithium-Ion Battery Dataset for Data Driven Models' Development**
Daniel Lotano, Politecnico di Bari, Italy
Marcantonio Catelani, University of Florence, Italy
Lorenzo Ciani, University of Florence, Italy
Nicola Giaquinto, Politecnico di Bari, Italy
Gabriele Patrizi, University of Florence, Italy
Marco Scarpetta, Politecnico di Bari, Italy
Maurizio Spadavecchia, Politecnico di Bari, Italy

12:10 **Smart Grid Fault Detection and Localization With Internet of Things: A Brief Survey**
Olli Väänänen, Jamk University of Applied Sciences, Finland
Mika Seppo Rantonen, Jamk University of Applied Sciences, Finland

12:30 **A Non-Invasive Measurement System for Pollutant Detection in Oil: A Preliminary Analysis**
Luca Tari, University of Cassino and Southern Lazio, Italy
Filippo Milano, University of Cassino and Southern Lazio, Italy
Luigi Ferrigno, University of Cassino and Southern Lazio, Italy
Aurelio Cesarano, University of Cassino and Southern Lazio, Italy
Davide Lanni, University of Cassino and Southern Lazio, Italy
Giovanni Erme, University of Cassino and Southern Lazio, Italy
Giorgio Ficco, University of Cassino and Southern Lazio, Italy
Gerardo Vuotto, Centro Diagnostico Baronia Srl, Italy
Renato Ciampa, Centro Diagnostico Baronia Srl, Italy

12:50 **Development of a Smart Sensor Framework for Predictive Maintenance**
Daniele Buonocore, University of Salerno, Italy
Marco Carratù, University of Salerno, Italy
Giuseppe Ciavolino, University of Salerno, Italy
Matteo Ferro, Metering Reseasch SRL, University of Salerno, Italy
Matteo Marino, University of Salerno, Italy
Vincenzo Paciello, University of Salerno, Italy

11:50 - 12:50 *Room 005 - Centro Didattico Morgagni*

Session 5.3 - Telecommunications of the Future for Industrial Networks - PART II

Chair: Stefano Caputo, *University of Florence, Italy*

11:50 **xSTART: xApp Simulated Evaluation Environment for Developers**

Juan Luis Herrera, University of Bologna, Italy
Sofia Montebugnoli, University of Bologna, Italy
Domenico Scotece, University of Bologna, Italy
Luca Foschini, University of Bologna, Italy

12:10 **Dynamic MEC Resource Management for URLLC in Industry X.0 Scenarios - a Quantitative Approach Based on Digital Twin Networks**

Marco Becattini, University of Florence, Italy
Leonardo Paroli, University of Florence, Italy
Giovanni Fontani, University of Florence, Italy
Laura Carnevali, University of Florence, Italy
Leonardo Scommegna, University of Florence, Italy
Maryam Masoumi, University of Valladolid, Spain
Ignacio de Miguel, University of Valladolid, Spain
Fabrizio Gabrio Brasca, WindTre, Italy

12:30 **Metasurfaces as 6G Enabling Technology: A Discussion on RIS Applicability to Industrial IoT Scenarios**

Alessia Tarozzi, University of Bologna, Italy
Enrico M. Vitucci, University of Bologna, Italy
Franco Fuschini, University of Bologna, Italy
Roberto Verdone, University of Bologna, Italy

13:10 - 14:30 *University of Florence - Centro Didattico Morgagni*

LUNCH

14:30 - 16:10 *Room 014 - Centro Didattico Morgagni*

Session 6.1 - Wearable Sensors and New Frontiers for Human Health Monitoring

Chairs: Daniela Lo Presti, *Università Campus Bio-Medico di Roma, Italy*
Mariangela Pinnelli, *Università Campus Bio-Medico di Roma, Italy*

14:30 **A 3D-Printed Multi-Parametric Wearable System for Monitoring Breathing Activity and Low Back Movements**

Daniela Lo Presti, Università Campus Bio-Medico di Roma, Italy
Martina Pulcinelli, Università Campus Bio-Medico di Roma, Italy
Carlo Massaroni, Università Campus Bio-Medico di Roma, Italy
Jan Nedoma, VSB-TUO, Czech Republic
Emiliano Schena, Università Campus Bio-Medico di Roma, Italy

14:50 **Monitoring Shoulder Flexion-Extension Movements Using a 3D-Printed Wearable Sensor Based on Fiber Bragg Grating Technology**
Alfredo Dimo, Fondazione Policlinico Universitario Campus Bio-Medico, Italy
Arianna Carnevale, Fondazione Policlinico Universitario Campus Bio-Medico, Italy
Martina Pulcinelli, Università Campus Bio-Medico di Roma, Italy
Carlo Massaroni, Università Campus Bio-Medico di Roma, Italy
Umile Giuseppe Longo, Università Campus Bio-Medico di Roma, Italy
Emiliano Schena, Università Campus Bio-Medico di Roma, Italy
Daniela Lo Presti, Università Campus Bio-Medico di Roma, Italy

15:10 **A Wearable Platform as a First Step Towards Enabling Collective Intelligence in Alzheimer's Disease Management: Feasibility Assessment on Healthy Volunteers**
Mariangela Pinnelli, Università Campus Bio-Medico di Roma, Italy
Chiara Romano, Università Campus Bio-Medico di Roma, Italy
Martina Pulcinelli, Università Campus Bio-Medico di Roma, Italy
Emiliano Schena, Università Campus Bio-Medico di Roma, Italy
Sergio Silvestri, Università Campus Bio-Medico di Roma, Italy
Giancarlo Fortino, University of Calabria, Italy
Carlo Massaroni, Università Campus Bio-Medico di Roma, Italy
Roberto Setola, Università Campus Bio-Medico di Roma, Italy
Daniela Lo Presti, Università Campus Bio-Medico di Roma, Italy

15:30 **A Technological Platform for Quantifying Alzheimer's Patient-Caregiver Interactions in the Walk and Talk Program**
Mariangela Pinnelli, Università Campus Bio-Medico di Roma, Italy
Nicola Camarda, Università Campus Bio-Medico di Roma, Italy
Chiara Romano, Università Campus Bio-Medico di Roma, Italy
Roberto Setola, Università Campus Bio-Medico di Roma, Italy
Sergio Silvestri, Università Campus Bio-Medico di Roma, Italy
Daniela Lo Presti, Università Campus Bio-Medico di Roma, Italy
Giancarlo Fortino, University of Calabria, Italy
Emiliano Schena, Università Campus Bio-Medico di Roma, Italy

15:50 **Comparison Between Heart Rate Estimated by Single-Lead ECG and Optical-Based Wearable Systems During Outdoor Running**
Carlo Massaroni, Università Campus Bio-Medico di Roma, Italy
Sergio Silvestri, Università Campus Bio-Medico di Roma, Italy
Emiliano Schena, Università Campus Bio-Medico di Roma, Italy

14:30 - 16:10 *Room 008 - Centro Didattico Morgagni*
Session 6.2 - Scalable Solutions for Early Detection of Neurological and Psychiatric Disorders
Chairs: Milena Čukić Radenković, *EMPA, Switzerland*
Tarmo Lipping, *Tampere University, Finland*

14:30 **Assessment of Mental Workload in Real-Life Setup Using EEG Synchronization Measures**
Tarmo Lipping, Tampere University, Finland
Matin Beiramvand, Tampere University, Finland

14:50 **An Early Dementia Risk Screening Approach for Healthy Aging Citizens**
Milena Cukic, EMPA, Switzerland
Simon Annaheim, EMPA, Switzerland
Patrick Eggenberger, EMPA, Switzerland
René Michel Rossi, EMPA, Switzerland

15:10 **Cloud Aggregation of Sensor Data: An Application on Mood Disorder Analysis**
Yury Andrea Jiménez Agud, CUNEF Universidad, Spain
Maria Soledad Espinosa, CUNEF Universidad, Spain
Milena Cukic, EMPA, Switzerland

15:30 **Multi-Class Machine Learning Detection of Edema, Vocal Paralysis and Vocal Nodules Through Voice**
Valerio Cesarini, University of Rome Tor Vergata, VoiceWise, Italy
Carlo Robotti, Guy's and St Thomas' NHS Foundation Trust, United Kingdom
Giovanni Costantini, University of Rome Tor Vergata, Italy

15:50 **Features of 3-D Phase Space Attractors as Descriptors of Chaotic Laws in Voice Signals for the AI-Based Detection of Dysphonia**
Valerio Cesarini, University of Rome Tor Vergata, VoiceWise, Italy
Mattia Magliocchetti, University of Rome Tor Vergata, Italy
Diego Calicchia, University of Rome Tor Vergata, Italy
Federica Amato, Politecnico di Torino, Italy
Antonio Suppa, Sapienza University of Rome, IRCCS Neuromed Institute, Italy
Francesco Asci, IRCCS Neuromed Institute, Italy
Luca Marsili, University of Cincinnati, USA
Giovanni Saggio, University of Rome Tor Vergata, Italy
Giovanni Costantini, University of Rome Tor Vergata, Italy

16:10 - 16:30 *University of Florence - Centro Didattico Morgagni*
COFFEE BREAK

16:30 - 17:50 *Room 014 - Centro Didattico Morgagni*
Session 7.1 - Cybersecurity Standards and Technologies for IoT and Industry 4.0 (SecurityStandards)
Chair: Raphael Machado, *Clavis Information Security, Brazil*

16:30 **Comparative Analysis of Cybersecurity Datasets in Industrial Control Systems**
Ines Martins, University of Lisbon, Portugal
José Cecílio, University of Lisbon, Portugal
Pedro M. Ferreira, University of Lisbon, Portugal
Alan Oliveira, University of Lisbon, Portugal

16:50 **Ransomware Detection: Leveraging Sandbox, Text Mining Techiques and Machine Learning**
Augusto Parisot, Universidade Federal Fluminense, Brazil
Lucila M. S. Bento, State University of Rio de Janeiro, Brazil
Raphael Machado, Inmetro and UFF, Brazil

17:10 **Autoencoder-Based Approach to Detect Stealth Cyberattacks in Battery Energy Storage Systems**
Mariana Flavio, National Institute of Metrology Quality and Technology, Brazil
Charles do Prado, National Institute of Metrology Quality and Technology, Brazil
Luiz Fernando Costa Carmo, National Institute of Metrology Quality and Technology, Brazil
Paolo Ferrari, University of Brescia, Italy
Marco Pasetti, University of Brescia, Italy
Alan Oliveira, University of Lisbon, Portugal

17:30 **Security Issues in Industrial Internet-Of-Things: Threats, Attacks and Solutions**
José Cecílio, University of Lisbon, Portugal
André Souto, University of Lisbon, Portugal

16:30 - 17:10 *Room 008 - Centro Didattico Morgagni*
Session 7.2 - Metrology for Zero-Defect Manufacturing
Chair: Alessandro Bartolini, *University of Florence, Italy*

16:30 **Evaluating Illumination Strategies for Neural-Based Surface Quality Assessment in Cold-Rolled Steel Production**
Luca Pini, Politecnico di Milano, Italy
Paolo Brambilla, Politecnico di Milano, Italy
Alessandro Barcatta, Itla-Bonaiti Srl, Italy
Francesca Ghislanzoni, Itla-Bonaiti Srl, Italy
Marco Tarabini, Politecnico di Milano, Italy

16:50 **Laser Line Triangulation Sensor With Wide Measurement Range: A Steel Industry Use Case**
Valentina Pasquinelli, Università Politecnica delle Marche, Italy
Milena Martarelli, Università Politecnica delle Marche, Italy
Nicola Paone, Università Politecnica delle Marche, Italy
Wilhelm Van De Kamp, VDL Weweler bv, The Netherlands
Bart Verhoef, VDL Weweler bv, The Netherlands

20:00 - 23:00 *Ristorante Santa Elisabetta - Brunelleschi Hotel*
GALA DINNER

Technical Program - Friday, May 31

09:30 - 10:30	*Room 014 - Centro Didattico Morgagni* **PLENARY SESSION - TUTORIAL** **Chair**: Lorenzo Ciani, *University of Florence, Italy*

Sensors and Data Acquisition Systems Available to Industry 4.0: An Application Case of how they are used to Automate a Production Line

Marco Ribichini, *DEWESOFT*

10:30 - 10:50	*University of Florence - Centro Didattico Morgagni* **COFFEE BREAK**

10:50 - 12:50	*Room 014 - Centro Didattico Morgagni* **Session 8.1 - Sensors for Medical Applications** **Chairs:** Francesca De Tommasi, *Università Campus Bio-Medico di Roma* Martina Pulcinelli, *Università Campus Bio-Medico di Roma*

10:50 **Assessment of an Innovative Smart Face Mask for the Estimation of Respiratory Rate in Static and Dynamic Conditions**
Lucrezia Giorgi, Università Campus Bio-Medico di Roma, Italy
Federico Di Marco, Università Campus Bio-Medico di Roma, Italy
Daniela Lo Presti, Università Campus Bio-Medico di Roma, Italy
Carlo Massaroni, Università Campus Bio-Medico di Roma, Italy
Chiara Romano, Università Campus Bio-Medico di Roma, Italy
Antonio Moffa, Fondazione Policlinico Universitario Campus Bio-Medico, Italy
Manuele Casale, Fondazione Policlinico Universitario Campus Bio-Medico, Italy
Emiliano Schena, Università Campus Bio-Medico di Roma, Italy

11:10 **Improvement of the LPG-D Probe With Sensors and Electronics for the Objective Assessment of Burn Scars in Pediatric Cases**
Francesco Dalle Mura, University of Florence, Italy
Monica Carfagni, University of Florence, Italy
Yary Volpe, University of Florence, Italy

11:30 **Design, Fabrication and Metrological Characterization of a 3D-Printed Tactile Sensor Based on Fiber Bragg Technology for Breast Palpation**
Martina Pulcinelli, Università Campus Bio-Medico di Roma, Italy
Lorenzo Zoboli, Università Campus Bio-Medico di Roma, Italy
Daniele Bianchi, Università Campus Bio-Medico di Roma, Italy

Carlo Massaroni, Università Campus Bio-Medico di Roma, Italy
Vittorio Altomare, Fondazione Policlinico Campus Bio-Medico, Italy
Antonella Grasso, Fondazione Policlinico Campus Bio-Medico, Italy
Alessio Gizzi, Università Campus Bio-Medico di Roma, Italy
Emiliano Schena, Università Campus Bio-Medico di Roma, Italy
Daniela Lo Presti, Università Campus Bio-Medico di Roma, Italy

11:50 **Plethysmography of Peripheral Artery Using Fiber Bragg Grating Sensors: Preliminary Results**
Mariaconsiglia Cuomo, University of Naples Parthenope, Italy
Vincenzo Romano Marrazzo, University of Naples Federico II, Italy
Elena De Vita, University of Naples Parthenope, Italy
Agostino Iadicicco, University of Naples Parthenope, Italy
Giovanni Breglio, University of Naples Federico II, Italy
Stefania Campopiano, University of Naples Parthenope, Italy

12:10 **Image Quality Assurance for B-Mode Diagnostic Ultrasound: Kiviat-Based Protocol First Application**
Giorgia Fiori, Roma Tre University, Italy
Maurizio Schmid, Roma Tre University, Italy
Jan Galo, IRCCS Children Hospital Bambino Gesù, Italy
Silvia Conforto, Roma Tre University, Italy
Salvatore Andrea Sciuto, Roma Tre University, Italy
Andrea Scorza, Roma Tre University, Italy

12:30 **Experimental Characterization of Zero-Power RFID-Based Strain Sensor for Implanted Fixators**
Alessio Mostaccio, University of Rome Tor Vergata, Italy
Carolina Miozzi, University of Rome Tor Vergata, Radio6ense srl, Italy
Sara Amendola, University of Rome Tor Vergata, Radio6ense srl, Italy
Cecilia Occhiuzzi, University of Rome Tor Vergata, Italy
Gaetano Marrocco, University of Rome Tor Vergata, Italy

10:50 - 12:50 *Room 008 - Centro Didattico Morgagni*
Session 8.2 - Advancement in Sensors and Measurements for Health - PART II
Chair: Mauro Serpelloni, *University of Brescia, Italy*

10:50 **The Effect of the Exposed Length of a Distributed Fiber-Optic Polarisation Sensor on the Temperature Measurement**
Zdenek Vylezich, University of Defense, Czech Republic
Martin Kyselak, University of Defense, Czech Republic
Jiri Vavra, University of Defense, Czech Republic
Marketa Vrsecka, University of Defense, Czech Republic

11:10 **Mobile Autonomous System for Measuring Pollutants in Indoor Environments**
Enrico Gagliardo, University of Brescia, Italy
Giorgia Polidori, University of Brescia, Italy
Mauro Serpelloni, University of Brescia, Italy

11:30 **Characterization Method for Bending Sensor Applied for Smart Glove**
Michela Borghetti, University of Brescia, Italy
Nicola Francesco Lopomo, Politecnico di Milano, Italy
Mauro Serpelloni, University of Brescia, Italy

11:50 **Influence of Apparent Wind on Particulate Matter Monitoring Through Low-Cost Sensors**
Paolo Castello, University of Cagliari, Italy
Carlo Muscas, University of Cagliari, Italy
Paolo Attilio Pegoraro, University of Cagliari, Italy
Davide Sitzia, University of Cagliari, Italy
Sara Sulis, University of Cagliari, Italy

12:10 **Design of Multi-Purpose Instrumented Gloves: Pressure Measurements Validation**
Bruno Andò, University of Catania, Italy
Danilo Greco, University of Catania, Italy
Mattia Manenti, University of Catania, Italy

12:30 **Design and Test of a Smart Sensor Box for Structural and Seismological Monitoring With a High-Performance QMEMS Accelerometer**
Gioacchino Fertitta, Istituto Nazionale di Geofisica e Vulcanologia, Italy
William Yang, Istituto Nazionale di Geofisica e Vulcanologia, Italy
Claudio Martino, Istituto Nazionale di Geofisica e Vulcanologia, Italy
Antonio Costanza, Istituto Nazionale di Geofisica e Vulcanologia, Italy
Francesco Macaluso, Istituto Nazionale di Geofisica e Vulcanologia, Italy
Domenico Patanè, Istituto Nazionale di Geofisica e Vulcanologia, Italy

12:40 - 14:00 *University of Florence - Centro Didattico Morgagni*
LUNCH

14:00 - 16:00 *Room 014 - Centro Didattico Morgagni*
Session 9.1 - Industry 4.0: Productivity, Sustainability and Enabling Technologies in the Framework of the PNRR and other founded projects
Chairs: Loredana Cristaldi, *Politecnico di Milano, Italy*
Parisa Esmaili, *Politecnico di Milano, Italy*

14:00 **A QCM-Based Device for Neurodegenerative Diseases Detection in Human Perspiration**
Ada Fort, University of Siena, Italy
Elia Landi, University of Siena, Italy
Riccardo Moretti, University of Siena, Italy
Valerio Vignoli, University of Siena, Italy
Mariagrazia Lettieri, University of Siena, Italy
Luigi Talarico, University of Siena, Italy
Marco Consumi, University of Siena, Italy
Agnese Magnani, University of Siena, Italy

14:20 **Health Indicator Effectiveness in Localized Fault Diagnosis: Rolling Bearing Elements**
Parisa Esmaili, Politecnico di Milano, Italy
Loredana Cristaldi, Politecnico di Milano, Italy

14:40 **A Transfer Learning Approach for Remaining Useful Life Estimation of Lithium-Ion Batteries**
Luca Martiri, Politecnico di Milano, Italy
Davide Azzalini, Politecnico di Milano, Italy
Loredana Cristaldi, Politecnico di Milano, Italy
Francesco Amigoni, Politecnico di Milano, Italy

15:00 **A Method for Sensing Passive Joints of Robotic Extra Fingers for Trajectory Tracking**
Elia Landi, University of Siena, Italy
Tommaso Lisini Baldi, University of Siena, Italy
Riccardo Moretti, University of Siena, Italy
Jonas Papenbrock, University of Pisa, Italy
Marco Mugnaini, University of Siena, Italy
Domenico Prattichizzo, University of Siena, Italy
Ada Fort, University of Siena, Italy

15:20 **GEO Satellite Internet of Things Node Architecture for Agrifood Supply Chain Traceability**
Giovanni Lasagni, University of Florence, Italy
Marco Badii, University of Florence, Italy
Giovanni Collodi, University of Florence, Italy
Monica Righini, University of Florence, Italy
Alessandro Cidronali, University of Florence, Italy

15:40 **XAI for Industrial Coating Processes in the Era of Industry 5.0**
Massimiliano Proietti, Idea-Re, Italy
Federico Bianchi, Idea-Re, Italy
Alessandro Vispa, Idea-Re, Italy
Lorenzo Sani, Idea-Re, Italy
Stefano Speziali, Idea-Re, Italy
Andrea Marini, Idea-Re, Italy
Alberto Garinei, Guglielmo Marconi University, Idea-Re, Italy
Marcello Marconi, Guglielmo Marconi University, Idea-Re, Italy
Emanuele Piccioni, Idea-Re, Italy

14:00 - 16:00	*Room 008 - Centro Didattico Morgagni* **Session 9.2 - Measurement tools and emerging approaches for human motion analysis** **Chairs:** Eduardo Palermo, *Sapienza University of Rome, Italy* Arianna Carnevale, *Fondazione Policlinico Universitario Campus Bio-Medico, Italy*

14:00 **A M-IMU-To-Segment Alignment Procedure for Shoulder Angles Estimation: A Preliminary Study**
Arianna Carnevale, Fondazione Policlinico Universitario Campus Bio-Medico, Italy
Martina Sassi, Università Campus Bio-Medico di Roma, Italy
Carla Antonacci, Università Campus Bio-Medico di Roma, Italy
Emiliano Schena, Università Campus Bio-Medico di Roma, Italy
Umile Giuseppe Longo, Fondazione Policlinico Universitario Campus Bio-Medico, Italy

14:20 **A Convolutional and Recurrent Neural Network-Based Control Algorithm for Ankle Exoskeleton: Validation of Performance Using IMU-Based Gait Analysis**
Lorenzo Liguori, Sapienza University of Rome, Italy
Livio D'Alvia, Sapienza University of Rome, Italy
Zaccaria Del Prete, Sapienza University of Rome, Italy
Eduardo Palermo, Sapienza University of Rome, Italy

14:40 **A Novel System Integrating Load Cell for Assessing Shoulder Muscle Strength**
Carla Antonacci, Università Campus Bio-Medico di Roma, Italy
Giulia Ghelli, Università Campus Bio-Medico di Roma, Italy
Arianna Carnevale, Fondazione Policlinico Universitario Campus Bio-Medico, Italy
Sergio Silvestri, Università Campus Bio-Medico di Roma, Italy
Emiliano Schena, Università Campus Bio-Medico di Roma, Italy
Umile Giuseppe Longo, Fondazione Policlinico Universitario Campus Bio-Medico, Italy

15:00 **Wearable Elastic Band Based on 3D-Printed Fiber Bragg Grating Sensor for Knee Joint Monitoring**
Martina Pulcinelli, Università Campus Bio-Medico di Roma, Italy
Daniela Lo Presti, Università Campus Bio-Medico di Roma, Italy
Carlo Massaroni, Università Campus Bio-Medico di Roma, Italy
Sergio Silvestri, Università Campus Bio-Medico di Roma, Italy
Emiliano Schena, Università Campus Bio-Medico di Roma, Italy
Francesca De Tommasi, Università Campus Bio-Medico di Roma, Italy

15:20 **Development of an Innovative 3D Printed Valve for Flow and Pressure Regulation in Industrial Plants**
Luca Pugi, University of Florence, Italy
Alessandro Madiai, University of Florence, Italy
Lorenzo Berzi, University of Florence, Italy
Nicola Giardini, Marchesini Group, Italy

15:40 **Quality Control for 3D Printing in Biomedical Applications: A Case Study on Dimensional Assessment of Skull Models**
Marta Cecchitelli, Roma Tre University, Italy
Giorgia Fiori, Roma Tre University, Italy
Jan Galo, IRCCS Children Hospital Bambino Gesù, Italy
Salvatore Andrea Sciuto, Roma Tre University, Italy
Andrea Scorza, Roma Tre University, Italy

16:00 - 16:20 *University of Florence - Centro Didattico Morgagni*
COFFEE BREAK

16:20 - 16:50	*Room 014 - Centro Didattico Morgagni* **CLOSING AND AWARD CEREMONY**