



2021 IEEE INTERNATIONAL WORKSHOP ON

METROLOGY FOR AGRICULTURE AND FORESTRY

TRENTO - BOLZANO, ITALY / NOVEMBER 3-5, 2021

WORKSHOP PROGRAM



MetroAgriFor
TRENTO-BOLZANO 2021

For further information, visit the website
www.metroagrifor.org

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MetroAgriFor
TRENTO-BOLZANO 2021

JAE Journal of Agricultural Engineering



sensors

an Open Access Journal by MDPI



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Welcome Message from the General Chairs

On behalf of the Organizing Committee, we cordially welcome you to the 2021 IEEE International Workshop on Metrology for the Agriculture and Forestry (*MetroAgriFor 2021*).

MetroAgriFor 2021 intends to create an active and stimulating forum where academics, researchers, and industry experts in measurement and data processing techniques for Agriculture, Forestry, and Food can meet and share new advances and research results.

Attention is paid, but not limited to, new technologies for agriculture and forestry environment monitoring, food quality monitoring, metrology-assisted production in agriculture, forestry and food industries, sensors and associated signal conditioning for agriculture and forestry, calibration methods for electronic test and measurement for environmental and food applications.

The first edition of *MetroAgriFor* was hosted by Polytechnic University of Marche, Italy, from an insightful and brilliant idea of Professor Enrico Primo Tomasini. He served as the first General Chair of this adventure. The Department of Agricultural Sciences, University of Naples "Federico II", Italy, hosted the second edition of the Workshop, with Leopoldo Angrisani, Pasquale Daponte and Matteo Lorito as General Chairs. The 3rd edition of *MetroAgriFor* was originally planned to be held in Trento (Italy), hosted by the University of Trento. However, due to the COVID-19 emergency, we were forced to organize this edition as a virtual conference. The virtual Workshop was planned to make an online conference, with a virtual environment where the attendees could present their papers, and could be engaged interacting in all sessions and activities. A special thanks to the organizing team, who professionally addressed this issue.

This year our expectation to have another chance to host you all in Trentino-Alto Adige and its world-famous Dolomites had success!! The programme is arranged to offer the possibility of visiting Trento during the first two days, and Bozen/Bolzano on the last day, thanks to a fruitful collaboration between the University of Trento and the Free University of Bozen-Bolzano. Such collaboration is constantly growing, especially on research topics of



agricultural engineering, actively carried out in both locations, which in Bozen/Bolzano also see the participation of the NOI-Techpark, which will host the final part of the event. At the end of the last day, it will also be possible to visit the new research laboratories of the NOI, where many of the topics addressed in the various sessions of the Conference are applied.

The *MetroAgriFor* Technical Program consists of 98 oral presentations scheduled over three days. Presentations are organized in a General Session and 15 Special Sessions. Special Sessions aim to create a focus on specific topics, where researchers can make knowledge, familiarize, exchange ideas, and build cooperation.

The received extended abstracts were submitted to a peer-review process. Relevance, quality, significance, and novelty of the scientific contribution were the main attributes taken into consideration 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.

Technically extended versions of presented papers can be submitted to:

- JAE (Journal of Agricultural Engineering), the official journal of the Italian Association of Agricultural Engineering (AIIA). JAE is supporting the *MetroAgriFor* Conference with two main initiatives; (i) a JAE *MetroAgriFor* Special Mention & Award will be assigned by an international evaluation board to the best paper on topics related to agricultural and forestry engineering among those presented by young researchers (<30 yrs old), the Award will consist on a bonus for a free-charge publication on JAE within the next 2 years; (ii) the same international evaluation board will select a set of 12 papers to be potentially included, after a regular review process, in a JAE Special Issues on *"Matching metrology and management issues in agricultural and forestry engineering applications"*.
- Special Issue on MDPI Agriculture, the topics of interest for this Special Issue include but are not limited to precision agriculture, precision horticulture, smart agriculture, metrology for farm pest control, Smart water management in agriculture, smart farm, and so on.

During the Workshop, attendees have the possibility to follow a tutorial on *"Present and future of sensors for the food industry"*, held by Annachiara Berardinelli, University of Trento.

MetroAgriFor 2021 is honored to have experts in smart agriculture and forestry as Invited Speakers.

- Prof. Javier Tardaguila of Televitis Research Group, University of La Rioja. Logroño, Spain, will open *MetroAgriFor 2021* with a lecture on "*Non-invasive technologies and smart applications in viticulture*".
- Prof. Maurizio Righetti, University of Bozen, Italy, will open the second day of works with a talk about "*Metrology challenges in the field of fluid dynamics applied to the control of agri-environmental and hydro-geological risks in the climate change era*".

We are grateful to the Invited Speakers for joining the Workshop.

To recognize the most outstanding paper presented at the annual *IEEE International Workshop on Metrology for Agriculture and Forestry*, 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 sponsored by MDPI Agriculture Journal, and to the Best Paper Presented by a Woman, this last sponsored by IEEE Women in Engineering, to recognize the full engagement of women in all aspects of the Metrology in Agriculture and Forestry. We sincerely want to thank all the sponsors and the patronages who made this event possible.

The 2021 *IEEE International Workshop on Metrology for Agriculture and Forestry* is about to begin. Metrologists, agriculture, forestry, food experts, and engineers, enjoy the Workshop!

November 2021

Davide Brunelli, University of Trento, Italy
Pasquale Daponte, University of Sannio, Italy
Fabrizio Mazzetto, University of Bolzano, Italy
MetroAgriFor2021 General Chairs

Message from the Technical Program Chairs

Welcome to the *2021 IEEE International Workshop on Metrology for Agriculture and Forestry (MetroAgriFor 2021)*, organized by the University of Trento and Free University of Bozen-Bolzano (Italy). *MetroAgriFor* previous editions were held in Ancona (2018), Portici (2019), and due to the COVID-19 pandemic on line (2020). *MetroAgriFor* established itself as an important world forum for discussing the latest advances in metrology for agriculture and forestry.

The Technical Program of *MetroAgriFor 2021* has 98 papers divided into 21 sessions distributed over the three days of the workshop, among which a general session, and 13 special sessions on specific themes. The general session has three parts and five special sessions have two parts. Special sessions aim at creating mini-workshops on specific topics where researchers working on the same area can be aware with each other's contributions to the creation of knowledge beyond the current state of the art. *MetroAgriFor* launched a call for special sessions and received a variety of different proposals from the session chairs.

1. General Session (2.3, 5.1, and 6.2)
2. Smart electronics and sustainable systems as key enabling technology in precision agriculture (1.1 and 2.1)
3. Smart technologies and digital infrastructure in agricultural, livestock and food-processing facilities (1.2 and 5.2)
4. Smart systems for land monitoring, analysis, management and planning (1.3)
5. Precision horticulture (2.2 and 4.1)
6. Emerging instrumentation for in-situ monitoring of physiological and soil parameters related to water-stress (3.1)
7. Livestock gaseous emissions, measurement and modelling techniques from barn to field (3.2)
8. Measurement and sensing techniques for estimating soil hydraulic characteristics and monitoring soil water dynamics (4.2)
9. Sensing hydrological processes at different spatial and temporal scales for sustainable use of water resources (5.3)

10. Advances in software tools for smart agriculture measurement (6.1)
11. Metrology for farm pests control: what contributions meeting technical efficacy, environmental sustainability and certification requirements (7.1)
12. Robotics for agro-forestry applications (7.2 and 8.2)
13. The role of digitization in agricultural sustainability (7.3 and 8.3)
14. Measuring methods for assessing biomass valorization routes in the agriforestry sector (8.1)

The Technical Program ends with a Technical Visit at NOI-TechPark of Bolzano and a Closing Drink Together.

We gratefully acknowledge the hard work of the Technical Program and Organizing Committees in the process of reviewing the papers and helping to shape the program and other activities, such as keynotes and tutorials. The International Program Committee is composed of dozens internal experts in the area of agriculture and forestry measurements. Also, we thank the dozens of reviewers who accepted to review papers in their specific expertise. Finally, we especially thank authors who honored the 4th edition of *MetroAgriFor*, submitting high-quality contributions with their research results. All these people played an important role in making this Workshop to come through.

We wish all participants a very enjoyable and professionally fruitful experience at *MetroAgriFor 2021*, where finally we have the opportunity to meet you all in person!!
Thanks to you all for your participation.

November 2021

Annachiara Berardinelli, *University of Trento, Italy*
Carlos Alberto Kamienski, *Federal University of ABC (UFABC) - Brazil*
Nunzio Isidoro, *Polytechnic University of Marche, Italy*
MetroAgriFor2021 Technical Program Chairs

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Pablo J. Zarco-Tejada, *The University of Melbourne, Australia*

IEEE MetroAgriFor 2021 Plenary Speakers

Plenary Thursday, November 4, 2021 - H 09:30

Non-invasive technologies and smart applications in viticulture

Javier Tardaguila

Televitis Research Group. University of La Rioja. Logroño, Spain

ABSTRACT

Emerging non-invasive technologies are being developed and applied in viticulture to improve grape production and to produce quality wines in a manner that is both environmentally and economically sustainable. In this work, we describe several of these non-invasive technologies as computer vision, chlorophyll fluorescence, thermography, spectroscopy and hyperspectral imaging for proximal or remote monitoring of the vineyards. The main objective of these new technologies is to obtain and supply data and information to grape growers and wine producers as a basis for improving decision-making process. The smart applications of these technologies in viticulture are discussed in relation nutrient and water status, pests and diseases, yield components and fruit composition.

SPEAKER BIO

Dr. **Javier Tardaguila** is Full Professor of Precision Viticulture at the University of La Rioja (Spain). Prof. Tardaguila works in precision viticulture, robotics and emerging technologies in agriculture. He was the Coordinator of VineRobot European project. Currently, he is working in NoPest H2020 project that develops non-destructive techniques of detecting plant diseases. He was involved in several European and national research projects in precision viticulture. He also is the author of over 90 publications in indexed journals (h index =30) and 3294 citations. He has been keynote speaker in several international conferences. Prof. Tardaguila has been actively involved in the technological transfer to the wine industry in collaboration to several national and international companies. He is Associate Editor of "Australian Journal of Grape and Wine Research". Prof. Tardaguila has been ViceChancellor of Research and Knowledge Transfer at the University of La Rioja.



Plenary Friday, November 5, 2021 - H 09:40

Metrology challenges in the field of fluid dynamics applied to the control of agri-environmental and hydro-geological risks in the climate change era

Maurizio Righetti

Free University of Bozen-Bolzano, Italy



ABSTRACT

Water and agriculture are inextricably linked, both as regards the problems of the use of water resources and those of defense against hydrogeological instability. Climate change induces significant changes in the water-agriculture relationship, accentuating problems and increasing the risks of agricultural operators. Increasingly intense events of instability (floods, landslides, mudslides and debris) affect the agro-forestry sector more and more frequently and with greater intensity. The agricultural sector, as it is closely linked to land and water, is increasingly called upon to carry out the functions of safeguarding the territory, actively contributing to the maintenance of minor waterways and mountain areas. A better knowledge of the dynamics of instability and the hydrodynamic behavior of "traditional" techniques for the arrangement of water courses, such as naturalistic engineering, can help in the fight against hydrogeological instability. In this presentation I will introduce some research results for understanding the dynamics of mud and debris flows and the hydraulic behavior of the arrangement of water courses with naturalistic engineering techniques, with particular attention to the methodologies and laboratory techniques used.

IEEE MetroAgriFor 2021 Tutorial

Thursday, November 4, 2021 - H 17:10

Present and future of sensors for the food industry

Annachiara Berardinelli

University of Trento, Italy

ABSTRACT

The talk will focus on off-line and on-line sensors for the rapid assessment of the chemical and physical properties and the microbial status of raw materials, process streams and end products.

Complex and variable samples in terms of chemical composition and physical structure in addition to hostile conditions and hygiene requirements represent challenging conditions for these sensors. The development and implementation of successful tools require a multidisciplinary approach focusing on the relationship between food properties and environment, on the transducer and electronics characteristics and on the statistical procedures.

SPEAKER BIO

Annachiara Berardinelli received the degree in Food Science and Technologies from the University of Bologna and the doctoral degree in Agricultural Engineering from University of Bologna. She is currently Assistant Professor at the University of Trento (Center of Agriculture, Food and Environment C3A and Department of Industrial Engineering). She is in charge to teach "Mechanization and precision viticulture" and "Innovative plants and automation for the agri-food production and transformation" courses.



She works on the assessment of physical and mechanical properties of agricultural products and on the development of systems for non-destructive determinations of biological product qualitative attributes, based on their optical, electric and dielectric properties and on the combination with multivariate and machine learning tools. Another area of work is the study of innovative solutions for non-thermal treatments of food products.

IEEE MetroAgriFor 2021 Workshop Venue

TRENTO - DAY 1 - NOVEMBER 3, 2021

VENUE 1 - Lunch, Welcome Party

Trento EXPO - Via Di Briamasco, 2

VENUE 2 – Registration, Opening Ceremony, Session 1.1, Session 1.2, Session 2.1, Session 2.2, Session 3.2, Session 4.2

Department of Economics and Management, University of Trento, Via Vigilio Inama, 5
Conference Hall - Seminar Room

VENUE 3 - Session 1.3, Session 2.3

Department of Sociology and Social Research, University of Trento, Via Verdi, 26
Room 7

VENUE 4 - Session 3.1

Faculty of Humanities, via Tommaso Gar, 14
Room 007

TRENTO - DAY 2 - NOVEMBER 4, 2021

VENUE 1 - Lunch

Trento EXPO - Via Di Briamasco, 2

VENUE 2 – Registration, Plenary Session, Session 5.1, Session 5.2, Tutorial

Department of Economics and Management, University of Trento, Via Vigilio Inama, 5
Conference Hall - Seminar Room

VENUE 3 - Session 5.3

Department of Sociology and Social Research, University of Trento, Via Verdi, 26
Kessler Room

VENUE 4 - Session 6.1

Faculty of Humanities, via Tommaso Gar, 14
Room 004

GALA DINNER

Forsterbräu Trento - Via Paolo Oss-Mazzurana, 38, Trento

BOLZANO - DAY 3 - NOVEMBER 5, 2021

TRANSFER TRENTO - BOLZANO

Meeting Point - Piazza Dante, Trento

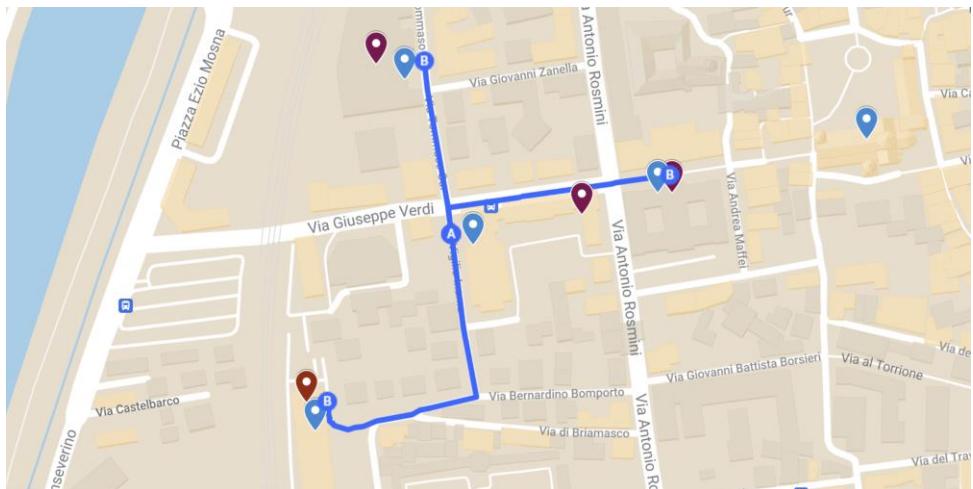
VENUE

NOI Techpark Alto Adige - Via Alessandro Volta, 13
Auditorium - Hall 1 - Hall 3 - Noisteria

TRENTO - MAP



Use the QR Code on the left to see the venue map on Google with your mobile device.



IEEE MetroAgriFor 2021 Social Events

WELCOME PARTY

Wednesday, November 3, 2021

18:40 - 20:30

The MetroAgriFor 2021 Welcome Party will be held at Trento EXPO

Address: Via Di Briamasco, 2 - Trento

GALA DINNER

Thursday, November 4, 2021

20:00 - 22:30

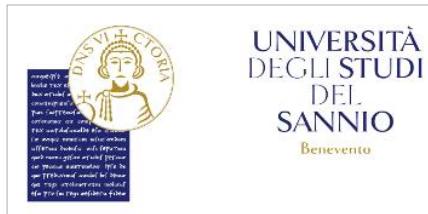
The MetroAgriFor 2021 Gala Dinner will be held at Restaurant Forsterbräu Trento

Address: Via Paolo Oss-Mazzurana, 38 - Trento

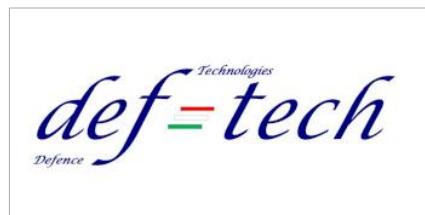


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Program Schedule - November 3, Trento

WEDNESDAY, NOVEMBER 3 - TRENTO			
09:00 - 09:30	Opening Ceremony - Welcome Addresses Conference Hall - Faculty of Economics		
09:30 - 11:10	Session 1.1 Smart electronics and sustainable systems as key enabling technology in precision agriculture - Part 1 Conference Hall - Faculty of Economics	Session 1.2 Smart technologies and digital infrastructure in agricultural, livestock and food-processing facilities - Part 1 Seminar Room - Faculty of Economics	Session 1.3 Smart systems for land monitoring, analysis, management and planning Room 7 - Faculty of Sociology
11:10 - 11:40	Coffee Break		
11:40 - 13:00	Session 2.1 Smart electronics and sustainable systems as key enabling technology in precision agriculture - Part 2 Conference Hall - Faculty of Economics	Session 2.2 Precision horticulture - Part 1 Seminar Room - Faculty of Economics	Session 2.3 General Session - Part 1 Room 7 - Faculty of Sociology
13:00 - 14:45	Lunch		
15:00 - 16:40	Session 3.1 Emerging instrumentation for in-situ monitoring of physiological and soil parameters related to water-stress Room 007 - Faculty of Humanities	Session 3.2 Livestock gaseous emissions, measurement and modelling techniques from barn to field Conference Hall - Faculty of Economics	
16:40 - 17:10	Coffee Break		
17:10 - 18:30	Session 4.1 Precision horticulture - Part 2 Room 007 - Faculty of Humanities	Session 4.2 Measurement and sensing techniques for estimating soil hydraulic characteristics and monitoring soil water dynamics Conference Hall - Faculty of Economics	
18:40 - 20:30	Welcome Party		

Program Schedule - November 4, Trento

THURSDAY, NOVEMBER 4 - TRENTO				
09:30 - 10:30	Plenary Talk - Non-invasive technologies and smart applications in viticulture <i>Javier Tardaguila</i> Conference Hall - Faculty of Economics			
10:30 - 11:00	Coffee Break			
11:00 - 12:40	Session 5.1 General Session Seminar Room - Faculty of Economics	Session 5.2 Smart technologies and digital infrastructure in agricultural, livestock and food-processing facilities - Part 2 Conference Hall - Faculty of Economics	Session 5.3 Sensing hydrological processes at different spatial and temporal scales for sustainable use of water resources Kessler Hall - Faculty of Sociology	
13:00 - 14:45	Lunch			
15:00 - 16:40	Session 6.1 Advances in software tools for smart agriculture measurement Room 004 - Faculty of Humanities		Session 6.2 General Session Conference Hall - Faculty of Economics	
16:40 - 17:10	Coffee Break			
17:10 - 18:00	Tutorial - Present and future of sensors for the food industry Annachiara Berardinelli, University of Trento Conference Hall - Faculty of Economics			
20:00	Gala Dinner			

Program Schedule - November 5, Bolzano

FRIDAY, NOVEMBER 5 - BOLZANO			
08:15 - 09:15	Bus Transfer Trento --> Bolzano (meeting point P.zza Dante, Trento)		
09:30 - 09:40	Welcome Addresses Hall 1 - NOI Techpark Alto Adige		
09:40 - 10:30	Plenary Talk - Metrology challenges in the field of fluid dynamics applied to the control of agri-environmental and hydro-geological risks in the climate change era <i>Maurizio Righetti</i> Hall 1 - NOI Techpark Alto Adige		
10:30 - 10:50	Coffee Break		
11:50 - 12:30	Session 7.1 Metrology for farm pests control: what contributions meeting technical efficacy, environmental sustainability and certification requirements Auditorium - NOI Techpark Alto Adige	Session 7.2 Robotics for agro-forestry applications - Part 1 Hall 1 - NOI Techpark Alto Adige	Session 7.3 The role of digitization in agricultural sustainability - Part 1 Hall 3 - NOI Techpark Alto Adige
12:30 - 13:50	Lunch		
13:50 - 15:30	Session 8.1 Measuring methods for assessing biomass valorization routes in the agroforestry sector Auditorium - NOI Techpark Alto Adige	Session 8.2 Robotics for agro-forestry applications - Part 2 Hall 1 - NOI Techpark Alto Adige	Session 8.3 The role of digitization in agricultural sustainability - Part 2 Hall 3 - NOI Techpark Alto Adige
15:30 - 16:00	Closing and Award Ceremony Auditorium - NOI Techpark Alto Adige		
16:00 - 17:00	Technical Visit at NOI-Techpark Alto Adige		
17:00 - 17:40	Closing Drink Together		

Technical Sessions - Wednesday, November 3

09:00 - 18:30

REGISTRATION

Room: Conference Hall (Faculty of Economics, via Vigilio Inama 5)

09:00 - 09:30

OPENING SESSION - WELCOME ADDRESSES

Room: Conference Hall (Faculty of Economics, via Vigilio Inama 5)

09:30 - 11:10

SESSION 1.1

Special Session - Smart electronics and sustainable systems as key enabling technology in precision agriculture - Part 1

Room: Conference Hall (Faculty of Economics, via Vigilio Inama 5)

Chairs: Luca Maiolo, *CNR-IMM, Italy*

Francesco Maita, *CNR-IMM, Italy*

09:30 Preliminary results from beehive activity monitoring using a 77 GHz FMCW radar sensor

Luca Dall'Asta, Fraunhofer Italia Research Innovation Engineering Center, Italy

Georg Egger, Fraunhofer Italia Research Innovation Engineering Center, Italy

09:50 A THz Imaging Scanner to Monitor Leaf Water Content

Manuel Greco, Università degli Studi "Roma Tre", Italy

Emilio Giovenale, ENEA, Fusion and Nuclear Dept, Italy

Fabio Leccese, Università degli Studi "Roma Tre", Italy

Andrea Doria, ENEA, Fusion and Nuclear Dept, Italy

Eduardo De Francesco, SeteL s.r.l, Italy

Gian Piero Gallerano, ENEA, Fusion and Nuclear Dept, Italy

10:10 droneONtrap project – Integration of IoT technologies and drones for health status and pests monitoring of orchards

Gianluca Ristorto, MAVTech srl, Italy

Alex Bojeri, MAVTech srl, Italy

Gabriele Scarton, Gruppo FOS SpA, Italy

Giovanni Giannotta, Gruppo FOS SpA, Italy

Giorgio Guglieri, Politecnico di Torino, Italy

10:30 Smart Monitoring Technologies for Defining Variability in Vineyard Microclimate, and Vinegrape Performances

Mauro Maesano, University of Tuscia, Italy

Federico Valerio Moresi, University of Tuscia, Italy

Manuel Greco, Università degli Studi "Roma Tre", Italy

Fabio Leccese, Università degli Studi "Roma Tre", Italy

Mariagrazia Leccisi, Università degli Studi "Roma Tre", Italy

Eduardo De Francesco, SeTel s.r.l., Italy

Elena Brunori, University of Tuscia, Italy

Rita Biasi, University of Tuscia, Italy

Giuseppe Scarascia Mugnozza, University of Tuscia, Italy

10:50 Measure of the deflections from linear trajectory of a skid-steer gantry tractor during its motion

Volodymyr Bulgakov, National University of Life and Environmental Sciences of Ukraine

Simone Pascuzzi, University of Bari Aldo Moro, Italy

Semjons Ivanovs, Latvia University of Life Sciences and Technologies, Latvia

Volodymyr Kuvachov, Tavria State Agrotechnological University, Ukraine

Hryhoriy Kaletnik, Vinnytsia National Agrarian University of Ukraine, Ukraine

Janusz Nowak, University of Life Sciences in Lublin, Poland

09:30 - 11:10

SESSION 1.2

Special Session - Smart technologies and digital infrastructure in agricultural, livestock and food-processing facilities - Part 1

Room: Seminar Room (Faculty of Economics, via Vigilio Inama 5)

Chairs: Carlo Bibbiani, *University of Pisa, Italy*

Andrea Pezzuolo, *University of Padua, Italy*

09:30 Automatic heart girth measurement for cattle based on deep learning

Ao Du, China Agricultural University, China
Hao Guo, China Agricultural University, China
Jie Lu, China Agricultural University, China
Yang Su, China Agricultural University, China
Alexey Ruchay, Russian Academy of Sciences, Russia
Andrea Pezzuolo, University of Padova, Italy

09:50 A cascaded model based on EfficientDet and YOLACT++ for instance segmentation of cow's collar ID tag in image

Kaixuan Zhao, Henan University of Science and Technology, China
Ruihong Zhang, Henan University of Science and Technology, China
Jiangtao Ji, Henan University of Science and Technology, China

10:10 Live weight prediction of cattle using deep image regression

Alexey Ruchay, Russian Academy of Sciences, Chelyabinsk State University, South Ural State University, Russia
Konstantin Dorofeev, Russian Academy of Sciences, Russia
Vsevolod Kalschikov, Russian Academy of Sciences, Russia
Vladimir Kolpakov, Russian Academy of Sciences, Russia
Kinispay Dzhulamanov, Russian Academy of Sciences, Russia
Hao Guo, China Agricultural University, China

10:30 Body Condition Score for Dairy Cows Method Based on Vision Transformer

Yufeng Wu, China Agricultural University, China
Hao Guo, China Agricultural University, China
Zhenbo Li, China Agricultural University, China
Qin Ma, China Agricultural University, China
Yuanyang Zhao, China Agricultural University, China
Andrea Pezzuolo, University of Padova, Italy

10:50 Research on denoising and segmentation algorithm application of pigs' point cloud based on DBSCAN and PointNet

Runheng Lin, China Agricultural University, China
Hao Hu, China Agricultural University, China
Zhikun Wen, China Agricultural University, China
Ling Yin, China Agricultural University, China

09:30 - 10:30

SESSION 1.3

Special Session - Smart systems for land monitoring, analysis, management and planning

Room: Room 7 (Faculty of Sociology, via Verdi 26)

Chairs: Daniele Torreggiani, *University of Bologna, Italy*

Maria Nicolina Ripa, *Tuscia University, Italy*

09:30 Assessing landscape fragmentation in Sardinia (Italy): A Comparative Analysis

Andrea De Montis, University of Sassari, Italy

Vittorio Serra, University of Sassari, Italy

Giovanna Calia, University of Cagliari, Italy

Maria Grazia Gavina Ruiu, University of Sassari, Italy

Antonio Ledda, University of Sassari, Italy

09:50 GIS based-model to locate and quantify agricultural wastes for sustainable building components: plastic films and sheep wool fibers

Monica C.M. Parlato, University of Catania, Italy

Simona M.C. Porto, University of Catania, Italy

Francesca Valenti, University of Catania, Italy

10:10 The impacts of Nature Based Solutions (NBS) on vegetated flows' dynamics in urban areas

Giuseppe Francesco Cesare Lama, University of Naples Federico II, Italy

Matteo Rillo Migliorini Giovannini, University of Florence, Italy

Alessandro Errico, University of Florence, Italy

Sajjad Mirzaei, Tarbiat Modares University, Iran

Giovanni Battista Chirico, University of Naples Federico II, Italy

Federico Preti, University of Florence, Italy

11:10 - 11:40

COFFEE BREAK

Room: Conference Hall (Faculty of Economics, via Vigilio Inama 5)

11:40 - 13:00

SESSION 2.1

Special Session - Smart electronics and sustainable systems as key enabling technology in precision agriculture - Part 2

Room: Conference Hall (Faculty of Economics, via Vigilio Inama 5)

Chairs: Luca Maiolo, *CNR-IMM, Italy*

Francesco Maita, *CNR-IMM, Italy*

11:40 Some Metrological Observations on the Use of the Exhaust Gas Temperature for the Indirect Measurement of the Torque in Agricultural Engines

Marco Bietresato, Free University of Bolzano, Italy

Francesco Selmo, Free University of Bolzano, Italy

Massimiliano Renzi, Free University of Bolzano, Italy

Fabrizio Mazzetto, Free University of Bolzano, Italy

12:00 Transistor-based plant sensors for agriculture 4.0 measurements

Saleh Hamed, Free University of Bolzano, Italy

Pietro Ibba, Free University of Bolzano, Italy

Mattia Petrelli, Free University of Bolzano, Italy

Manuela Ciocca, Free University of Bolzano, Italy

Paolo Lugli, Free University of Bolzano, Italy

Luisa Petti, Free University of Bolzano, Italy

12:20 Low power Wireless Sensor Network for precision agriculture: a battery-less operation scenario

Francesco Maita, Consiglio Nazionale delle Ricerche, Italy

Luca Maiolo, Consiglio Nazionale delle Ricerche, Italy

12:40 Comparing Routing Protocols for WSN in Agricultural Scenario

Mariagrazia Leccisi, Università degli Studi "Roma Tre", Italy

Marco Cagnetti, Università degli Studi "Roma Tre", Italy

Fabio Leccese, Università degli Studi "Roma Tre", Italy

Giuseppe Schirripa Spagnolo, Università degli Studi "Roma Tre", Italy

11:40 - 13:00

SESSION 2.2

Special Session - Precision horticulture - Part 1

Room: Seminar Room (Faculty of Economics, via Vigilio Inama 5)

Chairs: Lav Ramchandra Khot, *Washington State University, USA*

Luigi Manfrini, *University of Bologna, Italy*

Manuela Zude-Sasse, *Leibniz Institute for Agricultural Engineering and Bioeconomy*

11:40 Kiwifruit absorption and scattering properties obtained through postharvest shelf life using a laser backscattering imaging system

Zhuo Yang, MAF Digital Lab, Massey University, New Zealand

Mo Li, MAF Digital Lab, Massey University, New Zealand

Andrew East, MAF Digital Lab, Massey University, New Zealand

Manuela Zude-Sasse, Leibniz Institute for Agricultural Engineering and Bioeconomy (ATB),
Germany

12:00 Anomaly detection in plant growth in a controlled environment using 3D scanning techniques and deep learning

Iva Xhimitiku, University of Padua, Italy

Federico Bianchi, Idea-Re Srl, Italy

Massimiliano Proietti, Idea-Re Srl, Italy

Tommaso Tocci, University of Perugia, Italy

Andrea Marini, Idea-Re Srl, Italy

Lorenzo Menculini, Idea-Re Srl, Italy

Loris Francesco Termite, K-Digitale Srl, Italy

Edvige Pucci, Idea-Re Srl, Italy

Alberto Garinei, Guglielmo Marconi University, Italy

Marcello Marconi, Guglielmo Marconi University, Italy

Gianluca Rossi, University of Perugia, Italy

12:20 Apple orchard flower clusters density mapping by unmanned aerial vehicle RGB acquisitions

Mirko Piani, University of Bologna, Italy

Gianmarco Bortolotti, University of Bologna, Italy

Luigi Manfrini, University of Bologna, Italy

12:40 Comparison of various methods for estimation of reference evapotranspiration under four different precision farming structures

Chitra Shukla, Indian Institute of Technology Kharagpur, India

Debaditya Gupta, Indian Institute of Technology Guwahati, Assam

S. R. Bhakar, Maharana Pratap University of Agriculture & Technology Udaipur, Rajasthan

11:40 - 13:00

SESSION 2.3

General Session - Part 1

Room: Room 7 (Faculty of Sociology, via Verdi 26)

Chair: Matteo Nardello, *University of Trento, Italy*

11:40 Field-effect-transistor based biosensors: a review of their use in environmental monitoring applications

Giulia Elli, Free University of Bolzano, Italy

Manuela Ciocca, Free University of Bolzano, Italy

Paolo Lugli, Free University of Bolzano, Italy

Luisa Petti, Free University of Bolzano, Italy

12:00 Automatic inspection of baked goods based on costeffective RGB-D camera

Lorenzo Comba, Università degli Studi di Torino, Italy

Alessandro Biglia, Università degli Studi di Torino, Italy

Davide Ricauda Aimonino, Università degli Studi di Torino, Italy

Paolo Barge, Università degli Studi di Torino, Italy

Cristina Tortia, Università degli Studi di Torino, Italy

Paolo Gay, Università degli Studi di Torino, Italy

12:20 Evaluation of seeding unit equipped with shock absorber suspension on corn and sunflower

Kaihua Liu, University of Padova, Italy

Alessandro Zanchin, University of Padova, Italy

Marco Sozzi, University of Padova, Italy

Franco Gasparini, University of Padova, Italy

Marco Benetti, University of Padova, Italy

Luigi Sartori, University of Padova, Italy

12:40 2D tree crops training system improve computer vision application in field: a case study

Gianmarco Bortolotti, University of Bologna, Italy

Kushtrim Bresilla, Wageningen University & Research, Netherlands

Mirko Piani, University of Bologna, Italy

Luca Corelli Grappadelli, University of Bologna, Italy

Luigi Manfrini, University of Bologna, Italy

13:00 - 14:45

LUNCH

Room: Trento Expo (Via di Briamasco 2)

15:00 - 16:40

SESSION 3.1

Special Session - Emerging instrumentation for in-situ monitoring of physiological and soil parameters related to water-stress

Room: Room 007 (Faculty of Humanities, via Tommaso Gar 14)

Chairs: Dinko Oletić, *University of Zagreb, Croatia*

Sabine Rosner, *BOKU University, Institute of Botany, Austria*

Guillaume Charrier, *INRAE, PIAF laboratory, Clermont-Ferrand, France*

15:00 Verifying sensitivity of a sensor system for logging xylem's acoustic emissions related to drought stress

Dinko Oletić, *University of Zagreb, Croatia*

Sabine Rosner, *Universität für Bodenkultur Wien, Austria*

Vedran Bilas, *University of Zagreb, Croatia*

15:20 A low cost harmonically modulated chlorophyll fluorescence imaging system and frequency domain analysis of chlorophyll fluorescence

Dingle Jose, *University of Manchester, UK*

15:40 Non-contact Assessment of Apple Condition using Magnetic Induction Spectroscopy: Preliminary Results and Indications

Michael D. O'Toole, *The University of Manchester, UK*

Richard J. Colgan, *University of Greenwich, UK*

Alma Anvar, *The University of Manchester, UK*

Anthony J. Peyton, *The University of Manchester, UK*

16:00 Advanced monitoring system for agroecosystems threatened by salinisation and pollution

Marko Reljic, University of Zagreb, Croatia
Marina Bubalo Kovačić, University of Zagreb, Croatia
Gordon Gilja, University of Zagreb, Croatia
Monika Zovko, University of Zagreb, Croatia

16:20 Detecting cellular damages in freezing plants: are acoustic emissions useful?

Guillaume Charrier, PIAF - INRAE, France
Thierry Améglio, PIAF - INRAE, France
Stéphane Herbette, PIAF - INRAE, France
Lia Lamacque, PIAF - INRAE, France
Florian Sabin, PIAF - INRAE, France
Christophe Serre, PIAF - INRAE, France
Anna Wielemans, PIAF - INRAE, France

15:00 - 16:40

SESSION 3.2

Special Session - Livestock gaseous emissions, measurement and modelling techniques from barn to field

Room: Conference Hall (Faculty of Economics, via Vigilio Inama 5)

Chairs: Alberto Finzi, *University of Milan, Italy*
Marco Bovo, *University of Bologna, Italy*

15:00 Uncertainty in determining ammonia and methane emissions at different sampling locations in an open-sided dairy barn

Provvidenza Rita D'Urso, University of Catania, Italy
Claudia Arcidiacono, University of Catania, Italy
Giovanni Cascone, University of Catania, Italy

15:20 The landscape approach as support to the livestock manure management. The buffalo herds case-study in Sele plain, Campania region

Elena Cervelli, University of Naples Federico II, Italy
Ester Scotto di Perta, University of Naples Federico II, Italy
Antonio Mautone, University of Naples Federico II, Italy
Stefania Pindozzi, University of Naples Federico II, Italy

15:40 Testing the Efficiency of a Passive Sampler for Ammonia Monitoring and Comparison with Alpha-Samplers

Jacopo Maffia, University of Turin, Italy

Simone Pelissetti, UptoFarm s.r.l., Italy

Paolo Balsari, University of Turin, Italy

Elio Dinuccio, University of Turin, Italy

Dario Sacco, University of Turin, Italy

16:00 Ammonia concentration and recommended threshold values in pig farming: a review

Cecilia Conti, University of Milan, Italy

Federica Borgonovo, University of Milan, Italy

Marcella Guarino, University of Milan, Italy

16:20 Rapid and continuous monitoring of air ammonia concentration in dairy milking parlors

Andrea Pigni, University of Milan, Italy

Alessio Tugnolo, University of Milan, Italy

Roberto Beghi, University of Milan, Italy

Giacomo Cocetta, University of Milan, Italy

Alberto Finzi, University of Milan, Italy

16:40 - 17:10

COFFEE BREAK

Room: Conference Hall (Faculty of Economics, via Vigilio Inama 5)

17:10 - 18:30

SESSION 4.1

Special Session - Precision horticulture - Part 2

Room: Room 007 (Faculty of Humanities, via Tommaso Gar 14)

Chairs: Lav Ramchandra Khot, *Washington State University, USA*

Luigi Manfrini, *University of Bologna, Italy*

Manuela Zude-Sasse, *Leibniz Institute for Agricultural Engineering and Bioeconomy*

17:10 Improving accuracy and efficiency in plant detection on a novel, benchmarking real-world dataset
Laurenz Ohnemuller, Maastricht University, Netherlands
Alexia Briassouli, Maastricht University, Netherlands

17:30 High throughput canopy characterization of a commercial apple orchard using aerial RGB imagery
Gajanan S. Kothawade, Washington State University, United States
Abhilash K. Chandel, Washington State University, United States
M. Jacob Schrader, Washington State University, United States
Anura P. Rathnayake, Washington State University, United States
Lav R. Khot, Washington State University, United States

17:50 Geospatial apple canopy transpiration mapping: effect of in-field and open-field weather
Abhilash K. Chandel, Washington State University, United States
Lav R. Khot, Washington State University, United States
David J. Brown, Washington State University, United States
Claudio O. Stöckle, Washington State University, United States
R. Troy Peters, Washington State University, United States
Steve Mantle, innov8.ag, United States

18:10 Non-destructive Leaf Area Estimation of Tomato Using Mobile LiDAR Laser Scanner
Kowshik Kumar Saha, Technische Universität Berlin, Leibniz Institute for Agricultural Engineering and Bioeconomy, Germany
Cornelia Weltzien, Technische Universität Berlin, Leibniz Institute for Agricultural Engineering and Bioeconomy, Germany
Manuela Zude-Sasse, Leibniz Institute for Agricultural Engineering and Bioeconomy, Germany

17:10 - 18:10

SESSION 4.2

Special Session - Measurement and sensing techniques for estimating soil hydraulic characteristics and monitoring soil water dynamics

Room: Conference Hall (Faculty of Economics, via Vigilio Inama 5)

Chair: Luca Santoro, *University of Trento, Italy*

17:10 A Sensing-without-Sensors System for Soil Moisture Estimation

Riccardo Marini, WiLab, CNIT, University of Bologna, Italy

Enrico Testi, WiLab, CNIT, University of Bologna, Italy

Chiara Buratti, WiLab, CNIT, University of Bologna, Italy

Andrea Giorgetti, WiLab, CNIT, University of Bologna, Italy

Roberto Verdone, WiLab, CNIT, University of Bologna, Italy

17:30 The effects of management practices and fires on soil water dynamics at three locations across Europe

Jakub Jerabek, Czech technical university in Prague, Czech Republic

David Zumr, Czech technical university in Prague, Czech Republic

Tomas Dostal, Czech technical university in Prague, Czech Republic

Tomas R. Tenreiro, Institute for Sustainable Agriculture, Spain

Peter Strauss, Federal Agency for Water Management, Austria

Magdalena D. Vaverkova, Mendel University in Brno, Czech Republic

17:50 CRNS-based monitoring technologies for a weather and climate-resilient agriculture: realization by the ADAPTER project

Patrizia Ney, Forschungszentrum Julich GmbH, Germany

Markus Kohli, Heidelberg University, Germany

Heye Bogen, Forschungszentrum Julich GmbH, Germany

Klaus Goergen, Forschungszentrum Julich GmbH, Germany

18:40 - 20:30

WELCOME PARTY

Room: Trento Expo (Via di Briamasco 2)

Technical Sessions - Thursday, November 4

09:00 - 15:00

REGISTRATION

Room: Conference Hall (Faculty of Economics, via Vigilio Inama 5)

09:30 - 10:30

PLENARY SESSION

Room: Conference Hall (Faculty of Economics, via Vigilio Inama 5)

Chair: Annachiara Berardinelli, *University of Trento, Italy*

Non-invasive technologies and smart applications in viticulture

Javier Tardaguila, *Televitis Research Group, University of La Rioja, Logroño, Spain*

10:30 - 11:00

COFFEE BREAK

Room: Conference Hall (Faculty of Economics, via Vigilio Inama 5)

11:00 - 12:40

SESSION 5.1

General Session - Part 2

Room: Seminar Room (Faculty of Economics, via Vigilio Inama 5)

Chair: Matteo Nardello, *University of Trento, Italy*

11:00 Faster R-CNN and EfficientNet for Accurate Insect Identification in a Relabeled Yellow Sticky Traps Dataset

Maurice Deserno, Maastricht University, The Netherlands

Alexia Briassouli, Maastricht University, The Netherlands

11:20 Measurement of soil properties and surface hydrology parameters to assess the variation induced by different plantations

Chitra Shukla, Indian Institute of Technology Kharagpur, India

K. N. Tiwari, Indian Institute of Technology Kharagpur, India

Gurjeet Singh, NASA Jet Propulsion Laboratory, USA

11:40 High-Resolution Soil Moisture Retrieval Using C-Band Radar Sentinel-1 and Cosmic-ray Neutron Sensor Data

Hami Said, Joint FAO/IAEA Centre of Nuclear Techniques in Food and Agriculture, Austria

Modou Mbaye, CERAAS - ISRA, Sénégal

Lee Kheng Heng, Joint FAO/IAEA Centre of Nuclear Techniques in Food and Agriculture, Austria

Georg Weltin, Joint FAO/IAEA Centre of Nuclear Techniques in Food and Agriculture, Austria

Trenton Franz, University of Nebraska, USA

Gerd Dercon, Joint FAO/IAEA Centre of Nuclear Techniques in Food and Agriculture, Austria

Arsenio Toloza, Joint FAO/IAEA Centre of Nuclear Techniques in Food and Agriculture, Austria

Peter Strauss, Federal Agency for Water Management, Austria

Gerhard Rab, Federal Agency for Water Management, Austria

12:00 A data-driven framework for identifying productivity zones and the impact of agricultural droughts in sugarcane using SPI and unsupervised learning

Roberto Fray da Silva, University of São Paulo, Brazil

Gabriela Chiquito Gesualdo, University of São Paulo, Brazil

Marcos Roberto Benso, University of São Paulo, Brazil

Maria Clara Fava, Federal University of Viçosa, Brazil

Eduardo Mario Mendiondo, University of São Paulo, Brazil

Antonio Mauro Saraiva, University of São Paulo, Brazil

12:20 Automatic Spatial Rainfall Estimation on Limited Coverage Areas

Maria Clara Fava, Federal University of Viçosa, Brazil

Roberto Fray da Silva, University of São Paulo, Brazil

Gabriela Chiquito Gesualdo, University of São Paulo, Brazil

Marcos Roberto Benso, University of São Paulo, Brazil

Eduardo Mario Mendiondo, University of São Paulo, Brazil

Antonio Mauro Saraiva, University of São Paulo, Brazil

Alexandre Cláudio Botazzo Delbem, University of São Paulo, Brazil

Carlos Roberto Padovani, Brazilian Agricultural Research Corporation, Brazil

11:00 - 13:00

SESSION 5.2

Special Session - Smart technologies and digital infrastructure in agricultural, livestock and food-processing facilities - Part 2

Room: Conference Hall (Faculty of Economics, via Vigilio Inama 5)

Chair: Alberto Barbaresi, *University of Bologna, Italy*

11:00 Methodology for sensor calibration in agro-industrial facilities

Alberto Barbaresi, University of Bologna, Italy

Mattia Ceccarelli, University of Bologna, Italy

Miki Agrusti, University of Bologna, Italy

Marco Bovo, University of Bologna, Italy

Enrica Santolini, University of Bologna, Italy

Patrizia Tassinari, University of Bologna, Italy

Daniele Torreggiani, University of Bologna, Italy

11:20 A Low Power GPS-based device to develop KDE analyses for managing herd in extensive livestock systems

Simona M.C. Porto, University of Catania, Italy

Francesca Valenti, University of Catania, Italy

Giulia Castagnolo, University of Catania, Italy

Giovanni Cascone, University of Catania, Italy

11:40 Application of a smart dynamic scale for measuring live-fish biomass in aquaculture

Lorenzo Rossi, University of Pisa, Italy

Carlo Bibbiani, University of Pisa, Italy

Baldassare Fronte, University of Pisa, Italy

Eugenio Damiano, MEGA Materials s.r.l., Italy

Alberto Di Lieto, University of Pisa, Italy

12:00 Portable Photometer for Procyanidins Quantitation in Red Wine

Eleonora Iaccheri, University of Bologna, Italy

Arianna Ricci, University of Bologna, Italy

Giuseppina P. Parpinello, University of Bologna, Italy

Andrea Versari, University of Bologna, Italy

Luigi Ragni, University of Bologna, Italy

12:20 Digital Technologies and Automation in Livestock Production Systems: a Digital Footprint from Multisource Data

Andrea Pezzuolo, University of Padova, Italy
Hao Guo, China Agricultural University, China
Giorgio Marchesini, University of Padova, Italy
Marta Brscic, University of Padova, Italy
Stefano Guercini, University of Padova, Italy
Francesco Marinello, University of Padova, Italy

12:40 An IoT-based beer fermentation monitoring system

Daniele Buonocore, Spring Off s.r.l., Italy
Giuseppe Ciavolino, Spring Off s.r.l., Italy
Domenico Di Caro, Birring start-up innovativa s.r.l., Italy
Consolatina Liguori, University of Salerno, Italy

11:00 - 12:40

SESSION 5.3

Special Session - Sensing hydrological processes at different spatial and temporal scales for sustainable use of water resources

Room: Kessler Hall (Faculty of Sociology, via Verdi 26)

Chair: Gabriele Baroni, *University of Bologna, Italy*

11:00 A comparison between satellite- and model-based approaches developed in the ESA Irrigation+ project framework to estimate irrigation quantities

Sara Modanesi, National Research Council, Italy
Jacopo Dari, National Research Council, University of Perugia, Italy
Christian Massari, National Research Council, Italy
Angelica Tarpanelli, National Research Council, Italy
Silvia Barbutta, National Research Council, Italy
Gabriëlle De Lannoy, KU Leuven, Heverlee, Belgium
Alexander Gruber, KU Leuven, Heverlee, Belgium
Hans Lievens, KU Leuven, Heverlee, Belgium
Michel Bechtold, KU Leuven, Heverlee, Belgium
Raphael Quast, Research Unit Remote Sensing, TU Wien, Austria
Mariette Vreugdenhil, Research Unit Remote Sensing, TU Wien, Austria
Mehrez Zribi, CESBIO, France
Michel Le Page, CESBIO, France
Luca Brocca, National Research Council, Italy

11:20 Eco-hydrodynamic characterization of vegetated flows derived by UAV-based imagery

Giuseppe Francesco Cesare Lama, University of Naples Federico II, Italy

Mariano Crimaldi, University of Naples Federico II, Italy

Angela De Vivo, University of Naples Federico II, Italy

Giovanni Battista Chirico, University of Naples Federico II, Italy

Fabrizio Sarghini, University of Naples Federico II, Italy

11:40 Assessing spatial soil moisture patterns at a small agricultural catchment

Tailin Li, Czech Technical University in Prague, Czech Republic

Jakub Jeřábek, Czech Technical University in Prague, Czech Republic

David Zumr, Czech Technical University in Prague, Czech Republic

Nina Noreika, Czech Technical University in Prague, Czech Republic

Tomáš Dostál, Czech Technical University in Prague, Czech Republic

12:00 Assessing crop evapotranspiration by combining ERA5-Land meteorological reanalysis data and visible and near-infrared satellite imagery

Anna Pelosi, University of Salerno, Italy

Salvatore Falanga Bolognesi, Ariespace s.r.l., Italy

Guido D'Urso, University of Naples Federico II, Italy

Giovanni Battista Chirico, University of Naples Federico II, Italy

12:20 Assessment of a new non-invasive soil moisture sensor based on cosmic-ray neutrons

Stefano Gianessi, University of Bologna, Italy

Matteo Polo, FINAPP s.r.l., Italy

Luca Stevanato, FINAPP s.r.l., Italy

Marcello Lunardon, University of Padova, Italy

Hami Said Ahmed, Joint FAO/IAEA Centre of Nuclear Techniques in Food and Agriculture

Georg Weltin, Joint FAO/IAEA Centre of Nuclear Techniques in Food and Agriculture, Austria

Arsenio Toloza, Joint FAO/IAEA Centre of Nuclear Techniques in Food and Agriculture, Austria

Christian Budach, University of Potsdam, Germany

Peter Bíró, University of Potsdam, Germany

Till Francke, University of Potsdam, Germany

Maik Heistermann, University of Potsdam, Germany

Sascha E. Oswald, University of Potsdam, Germany

Emil Fulajtar, Joint FAO/IAEA Centre of Nuclear Techniques in Food and Agriculture, Austria

Gerd Dercon, Joint FAO/IAEA Centre of Nuclear Techniques in Food and Agriculture, Austria

Lee Kheng Heng, Joint FAO/IAEA Centre of Nuclear Techniques in Food and Agriculture

Gabriele Baroni, University of Bologna, Italy

13:00 - 14:45

LUNCH

Room: Trento Expo (Via di Briamasco 2)

15:00 - 16:40

SESSION 6.1

Special Session - Advances in software tools for smart agriculture measurement

Room: Room 004 (Faculty of Humanities, via Tommaso Gar 14)

Chairs: Carlos Kamienski, *Federal University of ABC, Brazil*

Gabriele Baroni, *University of Bologna, Italy*

15:00 Data Value Extraction Mechanism in a Resilient Fog-based IoT System for Smart Irrigation

Franklin M. Ribeiro Junior, *Federal University of ABC, Brazil*

Carlos A. Kamienski, *Federal University of ABC, Brazil*

15:20 Irrigation water saving estimation using soil moisture forecast simulation

Juha-Pekka Soininen, *VTT Technical Research Centre of Finland, Finland*

Kari Kolehmainen, *VTT Technical Research Centre of Finland, Finland*

Hannu Tanner, *VTT Technical Research Centre of Finland, Finland*

Jafar Golnabi, *Intercrop Iberica, Spain*

Ramide Augusto Sales Dantas, *Instituto Federal de Pernambuco, Brazil*

Gilberto Souza, *FEI University Center, Brazil*

15:40 IrrigaSim: An Irrigation Simulation, Processing, and Animation Environment

Ronaldo C. Prati, *Federal University of ABC, Brazil*

Fabrizio Borelli, *Federal University of ABC, Brazil*

Ivan Dimitry Zyrianoff, *University of Bologna, Italy*

Dener Silva, *Federal University of ABC, Brazil*

Rodrigo Togneri, *Federal University of ABC, Brazil*

Carlos Kamienski, *Federal University of ABC, Brazil*

16:00 Managing Smart Agriculture: the IoT Entity Management System (IoTEMS)

Fabrizio Borelli, *Federal University of ABC, Brazil*

Gabriela Biondi, *Federal University of ABC, Brazil*

Dener Silva, *Federal University of ABC, Brazil*

Carlos Kamienski, *Federal University of ABC, Brazil*

16:20 **A Soil Moisture Calibration Service for IoT-based Smart Irrigation**

Ivan Dimitry Zyrianoff, University of Bologna, Italy

André Torre Neto, EMBRAPA, Brazil

Dener Silva, Federal University of ABC, Brazil

Tullio Salmon Cinotti, University of Bologna, Italy

Marco Di Felice, University of Bologna, Italy

Carlos Kamienski, Federal University of ABC, Brazil

15:00 - 16:40

SESSION 6.2

General Session - Part 3

Room: Conference Hall (Faculty of Economics, via Vigilio Inama 5)

Chairs: Chiara Cevoli, *University of Bologna, Italy*

Luca Roffia, *University of Bologna, Italy*

15:00 **CFD modelling of gaseous emissions and dispersion from pig barn to surrounding areas**

Enrica Santolini, University of Bologna, Italy

Marco Bovo, University of Bologna, Italy

Alberto Barbaresi, University of Bologna, Italy

Shahad Hasan Flayyih Al-Rikabi, University of Bologna, Italy

Daniele Torreggiani, University of Bologna, Italy

Patrizia Tassinari, University of Bologna, Italy

15:20 **Process-oriented simulation and observations of N2O emission from intensively managed agricultural cropping system**

Terenzio Zenone, National Research Council, Italy

Lucia Oattaiano, University of Naples Federico II, Italy

Antonio Manco, National Research Council, Italy

Luca Vitale, National Research Council, Italy

Daniela Famulari, National Research Council, Italy

15:40 **Predict soil moisture into the future: on the integration of CRITERIA-1D into ZENTRA cloud**

Brenno Tondato de Faria, VAIMEE srl, Italy

Cristiano Aguzzi, VAIMEE srl, Italy

Travis Bates, METER Group, Inc., USA

Colin Campbell, METER Group, Inc., USA

Fausto Tomei, ARPAE Hydro-Meteo-Climate Service, Italy
Marco Bittelli, University of Bologna, Italy
Luca Roffia, VAIMEE srl, University of Bologna, Italy

16:00 Preliminary exploration of potential ponding impact on crop vigour using remote sensing techniques

Eugenio Straffelini, University of Padova, Italy
Anton Pijl, University of Padova, Italy
Fabio Turco, University of Padova, Italy
Paolo Tarolli, University of Padova, Italy

16:20 Potential of in-field Vis/NIR hyperspectral imaging to monitor quality parameters of alfalfa

Chiara Cevoli, University of Bologna, Italy
Luca Di Cecilia, CNH Industrial Italia SpA, Italy
Luca Ferrari, CNH Industrial Italia SpA, Italy
Angelo Fabbri, University of Bologna, Italy
Giovanni Molari, University of Bologna, Italy

16:40 - 17:10

COFFEE BREAK

Room: Conference Hall (Faculty of Economics, via Vigilio Inama 5)

17:10 - 18:05

TUTORIAL SESSION

Room: Conference Hall (Faculty of Economics, via Vigilio Inama 5)

Chair: Davide Brunelli, *University of Trento, Italy*

Present and future of sensors for the food industry

Annachiara Berardinelli, *University of Trento, Italy*

20:00 - 22:30

GALA DINNER

Ristorante Birreria Forsterbräu Trento - Via Paolo Oss-Mazzurana, 38, Trento

Technical Sessions - Friday, November 5

08:15 - 09:15

TRANSFER TRENTO - BOLZANO

Meeting Point: Piazza Dante, Trento

One ticket for the bus shuttle tranfer from Trento to Bolzano is included in the registration fee.
The bus will depart at 08:15 - Meeting Point Piazza Dante, Trento.

09:15 - 12:00

REGISTRATION

Room: NOI Techpark Alto Adige (Via Alessandro Volta, 13 - Bolzano)

09:30 - 09:40

WELCOME ADDRESSES

Room: Hall 1 - NOI Techpark Alto Adige

09:40 - 10:30

PLENARY SESSION

Room: Hall 1 - NOI Techpark Alto Adige

Chair: Fabrizio Mazzetto, *Free University of Bozen-Bolzano, Italy*

**Metrology challenges in the field of fluid dynamics applied to the control of
agri-environmental and hydro-geological risks in the climate change era**

Maurizio Righetti, *Free University of Bozen-Bolzano, Italy*

10:30 - 10:50

COFFEE BREAK

Place: Noisteria Cafè e Restaurant (Via Alessandro Volta, 15)

10:50 - 12:30

SESSION 7.1

Special Session - Metrology for farm pests control: what contributions meeting technical efficacy, environmental sustainability and certification requirements

Room: Auditorium - NOI Techpark Alto Adige

Chairs: Fabrizio Mazzetto, *Free University of Bozen-Bolzano, Italy*

Simone Pascuzzi, *University of Bari, Italy*

10:50 Spray Drop Size Measurement via Image Analysis

Emanuele Cerruto, University of Catania, Italy

Giuseppe Manetto, University of Catania, Italy

Domenico Longo, University of Catania, Italy

Rita Papa, University of Catania, Italy

11:10 A Brief Review of Nozzle Spray Drop Size Measurement Techniques

Simone Pascuzzi, University of Bari Aldo Moro, Italy

Giuseppe Manetto, University of Catania, Italy

Francesco Santoro, University of Bari Aldo Moro, Italy

Emanuele Cerruto, University of Catania, Italy

11:30 Indoor test bench measurements of potential spray drift generated by multi-row sprayers

Marco Grella, University of Turin, Italy

Paolo Marucco, University of Turin, Italy

Marco Manzone, University of Turin, Italy

Raimondo Gallo, Free University of Bozen, Italy

Fabrizio Mazzetto, Free University of Bozen, Italy

Paolo Balsari, University of Turin, Italy

11:50 Check and calibration of spraying machinery in Lombardy: activity results from 1999

Davide Facchinetti, University of Milan, Italy

Lavinia Eleonora Galli, University of Milan, Italy

Domenico Pessina, University of Milan, Italy

12:10 Feasibility study of using laser technology for calibrating orchard sprayer machinery. First results

Simone Pascuzzi, University of Bari Aldo Moro, Italy
Fabrizio Mazzetto, Free University of Bozen, Italy

10:50 - 12:30

SESSION 7.2

Special Session - Robotics for agro-forestry applications - Part 1

Room: Hall 1 - NOI Techpark Alto Adige

Chairs: Renato Vidoni, *Free University of Bozen-Bolzano, Italy*
Karl von Ellenrieder, *Free University of Bozen-Bolzano, Italy*
Dario Mengoli, *University of Bologna, Italy*

10:50 Improving agricultural drone localization using georeferenced low-complexity maps

Cesare Donati, Politecnico di Torino, Italy
Martina Mammarella, National Research Council, Italy
Lorenzo Comba, University of Torino, National Research Council, Italy
Alessandro Biglia, University of Torino, Italy
Fabrizio Dabbene, National Research Council, Italy
Paolo Gay, University of Torino, Italy

11:10 Wind Tunnel Testing of Remotely Piloted Aircraft Systems for Precision Crop-Spraying Applications

Nicoletta Bloise, Politecnico di Torino, Italy
Manuel Carreno Ruiz, Politecnico di Torino, Italy
Domenic D'Ambrosio, Politecnico di Torino, Italy
Giorgio Guglieri, Politecnico di Torino, Italy

11:30 Trajectory Planning ROS Service for an Autonomous Agricultural Robot

Lorenzo Gentilini, University of Bologna, Italy
Simone Rossi, University of Bologna, Italy
Dario Mengoli, University of Bologna, Italy
Andrea Eusebi, University of Bologna, Italy
Lorenzo Marconi, University of Bologna, Italy

11:50 Robust autonomous row-change maneuvers for agricultural robotic platform

Dario Mengoli, University of Bologna, Italy
Andrea Eusebi, University of Bologna, Italy

Simone Rossi, University of Bologna, Italy
Roberto Tazzari, University of Bologna, Italy
Lorenzo Marconi, University of Bologna, Italy

12:10 MAR - Multipurpose Amphibious Rover

Eduardo De Francesco, SeTel Group, Italy

10:50 - 12:30

SESSION 7.3

Special Session - The role of digitization in agricultural sustainability - Part 1

Room: Hall 3 - NOI Techpark Alto Adige

Chairs: Pasqualina Sacco, *Fraunhofer Italia IEC, Italy*

Francesco Marinello, *University of Padova, Italy*

10:50 A Blockchain implemented App for forestry nursery management

Simone Figorilli, CREA - Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria, Italy

Stefano Bruzzese, University of Torino, Italy

Andrea Rosario Proto, University of Reggio Calabria, Italy

Corrado Costa, CREA - Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria, Italy

Lavinia Moscovini, CREA - Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria, Italy

Simone Blanc, University of Torino, Italy

Filippo Brun, University of Torino, Italy

11:10 Italian Speech Commands for Forestry applications

Luciano Ortenzi, CREA - Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria, Italy

Giacomo Colle, Effetreseizer0 Srl, Italy

Corrado Costa, CREA - Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria, Italy

Lavinia Moscovini, CREA - Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria, Italy

11:30 Assessing the Digitalization Footprint from Agricultural Fields on Required Data Storage Space

Ahmed Kayad, University of Padova, Italy

Marco Sozzi, University of Padova, Italy

Andrea Pezzuolo, University of Padova, Italy

Stefano Grigolato, University of Padova, Italy
Francesco Marinello, University of Padova, Italy

11:50 farMAS: Multi-Agent based farm activity planning and execution system

Georg Egger, Fraunhofer Italia, Italy
Pasqualina Sacco, Fraunhofer Italia, Italy
Dmitry Chaltsev, Fraunhofer Italia, Italy
Fabrizio Mazzetto, Free University of Bozen, Italy

12:10 Life Cycle Assessment of Fertilization – Precision Soil Modeling Combined with Precision Agriculture

Francisco Medel Jimenez, BOKU - University of Natural Resources and Life Sciences Vienna, Austria
Iris Kral, BOKU - University of Natural Resources and Life Sciences Vienna, Austria
Andreas Gronauer, BOKU - University of Natural Resources and Life Sciences Vienna, Austria
Theresa Krexner, BOKU - University of Natural Resources and Life Sciences Vienna, Austria
Norbert Barta, BOKU - University of Natural Resources and Life Sciences Vienna, Austria
Gerhard Piringer, BOKU - University of Natural Resources and Life Sciences Vienna, Austria

12:30 - 14:00

LUNCH

Place: Noisteria Cafè e Restaurant (Via Alessandro Volta, 15)

14:00 - 15:20

SESSION 8.1

Special Session - Measuring methods for assessing biomass valorization routes in the agriforestry sector

Room: Auditorium - NOI Techpark Alto Adige
Chairs: Marco Baratieri, *Free University of Bozen-Bolzano, Italy*
Giuseppe Toscano, *Università Politecnica delle Marche, Italy*

14:00 Preliminary study on the application of a commercial LAI ceptometer for estimation of leaf production on low vigour mulberry trees

Domenico Giora, University of Padova, Italy
Federico Masin, University of Padova, Italy
Giuditta Marchetti, University of Padova, Italy
Alberto Assirelli, CREA - Council for Agricultural Research and Economics, Italy

Silvia Cappellozza, CREA - Council for Agricultural Research and Economics, Italy
Alessio Saviane, CREA - Council for Agricultural Research and Economics, Italy
Francesco Marinello, University of Padova, Italy
Luigi Sartori, University of Padova, Italy

14:20 Development of a method for determining the charcoal calorific value variability as integration of the UNI EN ISO 18125:2018 standard

Alessio Mencarelli, University of Padova, Italy
Raffaele Cavalli, University of Padova, Italy
Rosa Greco, University of Padova, Italy

14:40 Investigating biomass pyrolysis through intra-particle gas measurements

Francesco Patuzzi, Free University of Bozen, Italy
Simona Ciuta, City College of New York, USA
Frederic Marias, Universite de Pau et des Pays de l'Adour, France
Naomi Klinghoffer, Western University, Canada
Marco Baratieri, Free University of Bozen, Italy
Marco J. Castaldi, City College of New York, USA

15:00 Quality control of woodchip energy parameters using near infrared spectroscopy coupled with chemometrics

Manuela Mancini, University of Copenhagen, Denmark
Elena Leoni, Università Politecnica delle Marche, Italy
Giuseppe Toscano, Università Politecnica delle Marche, Italy

14:00 - 15:20

SESSION 8.2

Special Session - Robotics for agro-forestry applications - Part 2

Room: Hall 1 - NOI Techpark Alto Adige

Chairs: Renato Vidoni, *Free University of Bozen-Bolzano, Italy*
Karl von Ellenrieder, *Free University of Bozen-Bolzano, Italy*
Dario Mengoli, *University of Bologna, Italy*

14:00 Generating maneuverable trajectories for a reconfigurable underactuated agricultural robot

Helen Henninger, Free University of Bozen-Bolzano, Italy
Karl von Ellenrieder, Free University of Bozen-Bolzano, Italy

14:20 Increasing autonomy in agricultural robots: unevenness estimation of the terrain ahead

Antonio Leanza, Polytechnic of Bari, Italy

Rocco Galati, Polytechnic of Bari, Italy

Giulio Reina, Polytechnic of Bari, Italy

Annalisa Milella, National Research Council, Italy

14:40 Metrology-aware Path Planning for Agricultural Mobile Robots in Dynamic Environments

R. A. Saeed, Free University of Bozen-Bolzano, Italy

Giacomo Tomasi, Free University of Bozen-Bolzano, Italy

Ganesh Govindarajan, Free University of Bozen-Bolzano, Italy

Renato Vidoni, Free University of Bozen-Bolzano, Italy

Karl D. von Ellenrieder, Free University of Bozen-Bolzano, Italy

15:00 Design and evaluation of a brach sensing system for a climbing and pruning robot

Giovanni Carabin, Free University of Bozen-Bolzano, Italy

Fabrizio Mazzetto, Free University of Bozen-Bolzano, Italy

Renato Vidoni, Free University of Bozen-Bolzano, Italy

14:00 - 15:20

SESSION 8.3

Special Session - The role of digitization in agricultural sustainability - Part 2

Room: Hall 3 - NOI Techpark Alto Adige

Chairs: Pasqualina Sacco, *Fraunhofer Italia IEC, Italy*

Jacopo Bacenetti, *University of Milano, Italy*

14:00 Evaluation of Tracer dyes for spray deposit assessment in the vineyard

Rino Gubiani, University of Udine, Italy

Gianfranco Pergher, University of Udine, Italy

Nicola Zucchiatti, University of Udine, Italy

14:20 Connectivity in rural areas: a case study on internet connection in the Italian agricultural areas

Marco Sozzi, University of Padova, Italy

Ahmed Kayad, University of Padova, Italy

Giovanni Ferrari, University of Padova, Italy

Alessandro Zanchin, University of Padova, Italy
Stefano Grigolato, University of Padova, Italy
Francesco Marinello, University of Padova, Italy

14:40 Digital sustainability in smart agriculture

Pasqualina Sacco, Fraunhofer Italia, Italy
Elena Rangoni Gargano, Fraunhofer Italia, Italy
Alessia Cornella, Fraunhofer Italia, Italy
Davide Don, Fraunhofer Italia, Italy
Fabrizio Mazzetto, Free University of Bolzano, Italy

15:00 Can PocketNNI, a new smart app for Nitrogen Nutrition Index estimation, reduce the environmental impact of rice?

Livia Paleari, Università degli Studi di Milano, Italy
Michele Zoli, Università degli Studi di Milano, Italy
Jacopo Bacenetti, Università degli Studi di Milano, Italy
Roberto Confalonieri, Università degli Studi di Milano, Italy

15:20 - 15:50

CLOSING AND AWARD CEREMONY

Room: Hall 1 - NOI Techpark Alto Adige

15:50 - 17:00

TECHNICAL VISIT at NOI Techpark Alto Adige

17:00 - 17:30

CLOSING DRING TOGETHER

Place: Noisteria Cafè e Restaurant (Via Alessandro Volta, 15)
