

# **2021 IEEE International Workshop on Metrology for Agriculture and Forestry (MetroAgriFor 2021)**

**Trento-Bolzano, Italy  
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# WORKSHOP PROGRAM

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Wednesday, November 3

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## ***SESSION 1.1 - Special Session - Smart electronics and sustainable systems as key enabling technology in precision agriculture - Part 1***

**Room:** Conference Hall

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

Francesco Maita, CNR-IMM, Italy

**1 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*

**7 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*

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*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*

**17 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*

**22 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, 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*

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## ***SESSION 1.2 - Special Session - Smart technologies and digital infrastructure in agricultural, livestock and food-processing facilities - Part 1***

**Room:** Seminar Room

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

Andrea Pezzuolo, University of Padua, Italy

- 27 **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
- 32 **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  
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 Vladimir Kolpakov, Russian Academy of Sciences, Russia  
 Kinispay Dzhulamanov, Russian Academy of Sciences, Russia  
 Hao Guo, China Agricultural University, China
- 37 **Body Condition Score for Dairy Cows Method Based on Vision Transformer**  
 Yufeng Wu, China Agricultural University, China  
 Hao Guo, China Agricultural University, China  
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 Qin Ma, China Agricultural University, China  
 Yuanyang Zhao, China Agricultural University, China  
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- 42 **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

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### **SESSION 1.3 - Special Session - Smart systems for land monitoring, analysis, management and planning**

**Room:** Room 7

**Chairs:** Daniele Torreggiani, University of Bologna, Italy  
 Maria Nicolina Ripa, Tuscia University, Italy

- 48 **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
- 53 **GIS based-model to locate and quantify agricultural wastes for sustainable building components: plastic films and sheep wool fibers**  
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 Simona M.C. Porto, University of Catania, Italy  
 Francesca Valenti, University of Catania, Italy
- 58 **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

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## **SESSION 2.1 - Special Session - Smart electronics and sustainable systems as key enabling technology in precision agriculture - Part 2**

**Room:** Conference Hall

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

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Francesco Selmo, *Free University of Bolzano, Italy*  
Massimiliano Renzi, *Free University of Bolzano, Italy*  
Fabrizio Mazzetto, *Free University of Bolzano, Italy*

**69 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*

**75 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*

**80 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*

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## **SESSION 2.2 - Special Session - Precision horticulture - Part 1**

**Room:** Seminar Room

**Chairs:** Lav Ramchandra Khot, *Washington State University, USA*  
Luigi Manfrini, *University of Bologna, Italy*  
Manuela Zude-Sasse, *Leibniz Institute for Agricultural Engineering and Bioeconomy, Germany*

**86 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*

**92 Apple orchard flower clusters density mapping by unmanned aerial vehicle RGB acquisitions**

Mirko Piani, *University of Bologna, Italy*  
Gianmarco Bortolotti, *University of Bologna, Italy*  
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**97 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*

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## **SESSION 2.3 - General Session - Part 1**

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

**102 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*

**108 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*

**114 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*

**120 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*

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## **SESSION 3.1 - Special Session - Emerging instrumentation for in-situ monitoring of physiological and soil parameters related to water-stress**

**Room: Room 007**

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

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

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

**125 Verifying sensitivity of a sensor system for logging xylem's acoustic emissions related to drought stress**

*Dinko Oletic, University of Zagreb, Croatia*

*Sabine Rosner, Universität für Bodenkultur Wien, Austria*

*Vedran Bilas, University of Zagreb, Croatia*

**130 A low cost harmonically modulated chlorophyll fluorescence imaging system and frequency domain analysis of chlorophyll fluorescence**

*Dingle Jose, University of Manchester, UK*

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*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*

**140 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*

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**SESSION 3.2 - Special Session - Livestock gaseous emissions, measurement and modelling techniques from barn to field**

**Room: Conference Hall**

**Chairs:** Alberto Finzi, *University of Milan, Italy*

Marco Bovo, *University of Bologna, Italy*

**145 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*

**151 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*

**157 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*

**162 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*

**167 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*

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**SESSION 4.1 - Special Session - Precision horticulture - Part 2**

**Room: Room 007**

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

Luigi Manfrini, *University of Bologna, Italy*

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

**172 Improving accuracy and efficiency in plant detection on a novel, benchmarking real-world dataset**

*Laurenz Ohnemuller, Maastricht University, Netherlands*

*Alexia Briassouli, Maastricht University, Netherlands*

- 177 **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*
- 182 **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*
- 187 **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*

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#### **SESSION 4.2 - Special Session - Measurement and sensing techniques for estimating soil hydraulic characteristics and monitoring soil water dynamics**

**Room:** Conference Hall

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

- 192 **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*
- 197 **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*
- 203 **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 Bogena, Forschungszentrum Julich GmbH, Germany*  
*Klaus Goergen, Forschungszentrum Julich GmbH, Germany*

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**Thursday, November 4**

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#### **SESSION 5.1 - General Session - Part 2**

**Room:** Seminar Room

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



- 209 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*
- 215 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*  
*Surjeet Singh, NASA Jet Propulsion Laboratory, USA*
- 221 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*
- 226 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 Sao Paulo, Brazil*  
*Gabriela Chiquito Gesualdo, University of Sao Paulo, Brazil*  
*Marcos Roberto Benso, University of Sao Paulo, Brazil*  
*Maria Clara Fava, Federal University of Viçosa, Brazil*  
*Eduardo Mario Mendiondo, University of Sao Paulo, Brazil*  
*Antonio Mauro Saraiva, University of Sao Paulo, Brazil*
- 232 Automatic Spatial Rainfall Estimation on Limited Coverage Areas**  
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*Gabriela Chiquito Gesualdo, University of Sao Paulo, Brazil*  
*Marcos Roberto Benso, University of Sao Paulo, Brazil*  
*Eduardo Mario Mendiondo, University of Sao Paulo, Brazil*  
*Antonio Mauro Saraiva, University of Sao Paulo, Brazil*  
*Alexandre Cláudio Botazzo Delbem, University of Sao Paulo, Brazil*  
*Carlos Roberto Padovani, Brazilian Agricultural Research Corporation, Brazil*

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**SESSION 5.2 - Special Session - Smart technologies and digital infrastructure in agricultural, livestock and food-processing facilities - Part 2**

**Room:** Conference Hall

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

- 238 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*
- 243 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*

- 248 **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*
- 253 **Portable Photometer for Procyanidins Quantitation in Red Wine**  
*Eleonora Iaccheri, University of Bologna, Italy*  
*Arianna Ricci, University of Bologna, Italy*  
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*Andrea Versari, University of Bologna, Italy*  
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- 258 **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*
- 263 **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*

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### **SESSION 5.3 - Special Session - Sensing hydrological processes at different spatial and temporal scales for sustainable use of water resources**

**Room: Kessler Hall**

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

- 268 **A comparison between satellite- and model-based approaches developed in the ESA Irrigation+ project framework to estimate irrigation quantities**  
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*Jacopo Dari, National Research Council, University of Perugia, Italy*  
*Christian Massari, National Research Council, Italy*  
*Angelica Tarpanelli, National Research Council, Italy*  
*Silvia Barbetta, 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*
- 273 **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*

- 279 **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*
- 285 **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*
- 290 **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, Austria*  
*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, Austria*  
*Gabriele Baroni, University of Bologna, Italy*

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## **SESSION 6.1 - Special Session - Advances in software tools for smart agriculture measurement**

**Room: Room 004**

**Chairs:** *Carlos Kamienski, Federal University of ABC, Brazil*  
*Gabriele Baroni, University of Bologna, Italy*

- 295 **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*
- 300 **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*  
*Ramido Augusto Sales Dantas, Instituto Federal de Pernambuco, Brazil*  
*Gilberto Souza, FEI University Center, Brazil*
- 305 **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*

**310 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*

**315 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*

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**SESSION 6.2 - General Session - Part 3**

**Room: Conference Hall**

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

**320 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*

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

*Terenzio Zenone, National Research Council, Italy  
Lucia Ottaiano, University of Naples Federico II, Italy  
Antonio Manco, National Research Council, Italy  
Luca Vitale, National Research Council, Italy  
Daniela Famulari, National Research Council, Italy*

**331 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*

**336 Preliminary exploration of potential ponding impact on crop vigour using remote sensing techniques**

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

**341 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*

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**Friday, November 5**

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**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*

**346 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*

**351 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*

**356 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*

**362 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*

**367 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*

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

**372 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*

**378 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*

**384 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*

**390 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*

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**SESSION 7.3 - Special Session - The role of digitization in agricultural sustainability - Part 1**

**Room: Kessler Hall**

**Chair:** Pasqualina Sacco, *Fraunhofer Italia IEC, Italy*  
Francesco Marinello, *University of Padova, Italy*

**396 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*

**401 Italian Speech Commands for Forestry applications**

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

**406 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*

**411 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*

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**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*



- 416 **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*
- 422 **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*
- 427 **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*
- 432 **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*

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## **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, *Free University of Bozen-Bolzano, Italy*

- 436 **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*
- 442 **Increasing autonomy in agricultural robots: unevenness estimation of the terrain ahead**  
*Antonio Lanza, Polytechnic of Bari, Italy*  
*Rocco Galati, Polytechnic of Bari, Italy*  
*Giulio Reina, Polytechnic of Bari, Italy*  
*Annalisa Milella, National Research Council, Italy*
- 448 **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*
- 454 **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*

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## **SESSION 8.3 - Special Session - The role of digitization in agricultural sustainability - Part 2**

**Room: Kessler Hall**

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

Francesco Marinello, *University of Padova, Italy*

460 **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*

466 **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*

471 **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*

476 **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*