

Special Session Proposal

Special Session Basic Information:

Session Title	Machine Vision Meets Agriculture 5.0
Introduction and topics	
Agriculture is undergoing a profound transformation driven by the need to increase productivity while reducing environmental impact and resource consumption. As global food demand rises and climate pressures intensify, the transition toward precision and sustainable farming has become a strategic priority. Within this shift, often referred to as Agriculture 5.0, machine vision has emerged as a key enabling technology, offering non-invasive, scalable, and cost-effective means of perceiving, monitoring, and analyzing crops, soil, and farming environments. Recent advances in imaging sensors, deep learning, and autonomous platforms, including unmanned aerial vehicles (UAVs), ground robots, and edge devices, have significantly expanded the capabilities of vision-based systems in the field. These technologies now support tasks ranging from early disease and pest detection, yield estimation, and weed identification to fruit quality assessment, phenotyping, and targeted intervention. By enabling data-driven, site-specific decisions, machine vision contributes directly to reducing the use of water, fertilizers, and pesticides, advancing both the economic and ecological sustainability of agricultural production. Despite this progress, substantial challenges remain, including robustness under variable field conditions, limited annotated datasets, model generalization across crops and regions, real-time processing on resource-constrained devices, and the integration of vision with complementary sensing modalities and digital twin frameworks. These challenges make agriculture a compelling and demanding testbed for fundamental advances in machine vision. This special session aims to bring together researchers and practitioners from machine vision, machine learning, robotics, and agricultural sciences to present recent advances, share datasets and methodologies, and discuss open problems at the intersection of visual perception and sustainable agriculture. We welcome original research contributions, application-oriented studies, and reviews that advance the state-of-the-art in this rapidly growing interdisciplinary field.	
Topics of Interest	
The session invites, but is not limited to, contributions on the following topics: • Image-based detection and diagnosis of plant diseases and pests • Weed detection and species-specific classification for low-chemical targeted spraying • Crop and fruit quality assessment and grading using vision • Yield estimation, fruit counting, and harvest prediction • Plant phenotyping and growth monitoring • UAV- and satellite-based remote sensing for crop and field analysis • Ground and aerial agricultural robots with vision-based perception • Deep learning architectures for agricultural image analysis • Multispectral, hyperspectral, and thermal imaging in agriculture • Multimodal sensor fusion (vision, environmental, and acoustic sensors) • Real-time and edge-based machine vision for in-field deployment • Digital twins and vision-driven decision-support systems • Soil and land condition assessment through imaging • Datasets, benchmarks, and annotation strategies for agricultural vision • Cross-field and cross-season datasets for generalizable detection models • Integration of interpretability methods for producers' trust in model predictions • Quantum-enhanced computer vision for sustainable precision agriculture • Explainable and trustworthy vision systems for ethical agricultural applications	

- Resource-efficient and sustainable farming enabled by visual perception

Special Session Chair(s):

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Organizer's Brief Biography

GEORGE A. PAPAKOSTAS received the Diploma, M.Sc., and Ph.D. degrees in electrical and computer engineering from the Democritus University of Thrace (DUTH), Kavala, Greece, in 1999, 2002, and 2007, respectively. He is currently a tenured Full Professor with the Department of Informatics, DUTH, and the Head of the Machine Learning and Vision (MLV) Research Group. He has over 15 years of experience in large-scale systems design, serving as both a Senior Software Engineer and the Technical Manager. He has been included in the top 2% of researchers worldwide for the years 2022, 2023, and 2024 in the field of "Artificial Intelligence and Image Processing" according to the Stanford University list. He has (co)-authored more than 300 publications in indexed journals, international conferences, and book chapters, including one book (in Greek), three edited books, five conference proceedings, and nine journal special issues. His work has received more than 7400 citations, with an H-index of 46 (Google Scholar). His research interests include machine learning, computer and machine vision, pattern recognition, and computational intelligence. He serves as an Associate Editor for the journals *Multimedia Tools and Applications*, *PeerJ Computer Science*, *Electronics*, and *Digital*. He is a member of the IAENG, MIR Labs, EUCogIII, and the Technical Chamber of Greece (TEE), and he has served as a reviewer for numerous journals and conferences.

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Organizer's Brief Biography

ELENI VROCHIDOU received her Diploma [Embedded Systems], her Master Diploma [Automatic Control Systems] and her PhD [Signal Processing] in the Department of Electrical and Computer Engineering, Democritus University of Thrace (DUTH) in 2004, 2007 and 2016, respectively. She has been working as a research staff member in the Department of Informatics of DUTH since 2005, where she has taught undergraduate and postgraduate courses. Since 2024 she has been an Assistant Professor. Her main research interests include signal processing and analysis, intelligent systems, pattern recognition and machine learning, on which she has several scientific publications. She is a member of the "Machine Learning and Vision" research group (MLV Research Group).

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THEOFANIS KALAMPOKAS received the PhD degree in the Department of Informatics, Democritus University of Thrace (DUTH), Kavala, Greece. He received the degree in software engineering and the M.Phil. degree in advanced technologies in informatics and computers from the Department of Computer Science, International Hellenic University, Kavala, in 2018 and 2021, respectively. Since 2021, he has been a member of the Machine Learning and Vision (MLV) Research Group, where he participates in research projects. His main research interests include image processing, artificial intelligence, machine learning, deep-learning techniques, quantum computing and quantum machine learning.

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VLADAN PAPIĆ received the PhD degree from University of Split, Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture, Split, Croatia in 2002. Since 2002 he has been working on University of Split at Faculty of Science (2002-2009) and Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture (2009-now). He participated in several scientific projects as a leading scientist or researcher. Currently, he is full professor with tenure at the Department of Electronics and Computing. He is leader of research group "Computer intelligence for recognition and support of human activities". His main research interests include computer vision, artificial intelligence, machine learning, precision agriculture and robotics.