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Invited Talk

Recent Advances in Computer Graphics Vegetation Modeling

Bedrich Benes

Professor and Associate Head of Computer Science at Purdue University

Abstract

Trees belong to the most visually appealing and complex structures in Nature. They have unmeasurable effects on humans as they are an essential part of the atmosphere, but they also have substantial positive value on our well-being. Computer science has tried to capture and decipher tree shape and its development for over forty years, with one of the goals being to build tree digital twins – a computer representation that responds to the environment, is simulation-ready, and can be used to answer the “what-if” scenarios.

This presentation will showcase several recent advances enabled by the deep neural representation of mathematical models of trees, including their development. We will show how tree representations can be learned from data, particularly vegetation capture using LiDAR or single images. We will discuss how L-systems can be learned by the transformer and how a novel deep representation can encapsulate the tree’s environmental and growth parameters by learning them from simulated data. We will also show several recent methods that combine physics for showing the dynamics of plant growth and interaction with the environment.

Biographical Note

Bedrich Benes is a Professor and Associate Head of Computer Science at Purdue University. He received his Ph.D. from Czech Technical University in Prague in 1998. Bedrich is a Fellow of the European Association for Computer Graphics (Eurographics) and a senior member of ACM and IEEE. He is the editor-in-chief of Elsevier Graphical Models and was a paper co-chair of Eurographics 2017. Dr. Benes works in generative methods for geometry synthesis and deep learning, focusing on procedural and inverse procedural modeling, simulation of natural phenomena, and additive manufacturing. He has published over 200 research papers and has been sponsored by the National Science Foundation, NASA, Adobe Research, Intel, Siemens, Samsung, the Department of Energy, and Ford Inc., among others. Bedrich is a Purdue University faculty scholar.

Invited Talk

The Importance of Technology in the Future Operational Landscape

Ildefonso Vera

Director of Innovation, Processes, and Digital Transformation. ISDEFE

Abstract

Technology has become a decisive factor in modern operational scenarios, transforming both the way missions are planned and executed and the individual capabilities of the combatant. In the operational field, the use of advanced communication systems, artificial intelligence, remote sensors, and unmanned platforms (such as drones and ground robots) enables more accurate situational awareness, faster decision-making, and safer operations.

For the future combatant, technology represents a comprehensive enhancement of their physical and cognitive capabilities. Exoskeletons, augmented reality systems, smart visors, and suits with biometric sensors increase their endurance, precision, and coordination with allied units. Furthermore, access to real-time information and support from artificial intelligence algorithms optimize their performance and reduce risks in hostile environments.

Together, the integration of technology in operational environments and in combatant equipment redefines the nature of modern warfare, increasing operational efficiency, reducing exposure to danger, and enhancing strategic superiority.

Biographical Note

Ildefonso Vera is the Director of Innovation, Processes, and Digital Transformation at Ingeniería de Sistemas para la Defensa de España. A technology professional with solid experience in Digital Transformation, Cybersecurity, and Change Management. Passionate about innovation and strategic planning. Proven ability to lead teams and projects, implement robust security solutions, and manage change effectively.

Invited Talk

Integrating Remote Sensing Technologies and Artificial Intelligence for Enhanced Data Generation in Precision Agriculture Modeling and Simulation

Joao Moreira

Associate Professor with Habilitation at the UTAD and a researcher at INESC TEC

Abstract

Precision agriculture has significantly advanced with the integration of remote sensing technologies—such as satellite imagery, unmanned aerial vehicles (UAVs), and proximity sensors—alongside artificial intelligence (AI). This convergence facilitates the creation of comprehensive datasets essential for realistic modeling and simulation of agricultural scenarios.

In this presentation, we will explore innovative methodologies for collecting, processing, and analyzing data from diverse remote sensing sources. We will discuss how the fusion of these data, enhanced by machine learning algorithms, improves the accuracy and applicability of agricultural models. Case studies will be presented to demonstrate the effectiveness of these approaches in crop yield prediction, monitoring plant health, and optimizing resource utilization.

Furthermore, we will address challenges associated with integrating data from various sensors, including issues of compatibility, spatial and temporal resolution, and the necessity for cross-calibration. We will also highlight emerging opportunities through the use of advanced AI techniques to extract valuable insights from large volumes of agricultural data.

Biographical Note

Joaquim João Moreira de Sousa is an Associate Professor with Habilitation at the University of Trás-os-Montes and Alto Douro (UTAD) and a researcher at INESC TEC (Institute for Systems and Computer Engineering, Technology, and Science) and CITAB (Centre for Research and Technologies in Agro-Environmental and Biological Sciences). His work focuses on the application of proximity sensing and remote sensing technologies for precision agriculture, particularly in the fields of viticulture and oenology. With over 200 scientific publications and extensive experience in Artificial Intelligence, Radar Interferometry (InSAR), and Computer Graphics, he has led numerous national and international research projects aimed at optimizing agricultural practices through technological innovation.

Invited Talk

Raul Morais

Full Professor in the Department of Engineering at the UTAD

Biographical Note

Raul Morais dos Santos is a Full Professor in the Department of Engineering at the University of Trás-os-Montes and Alto Douro (UTAD). His main areas of interest include: sensors and sensory interfaces in microelectronics, energy harvesting techniques for powering electronic devices, wireless sensor networks in precision agriculture/viticulture contexts, embedded devices for data acquisition in agroforestry contexts, remote monitoring with UAVs, data integration platforms, the Internet of Things, Big Data, analytics, and artificial intelligence. He also has interests in the field of implantable biomedical devices, particularly in biotelemetry systems and micro-vibrational generators for energy production inside implantable devices. Within his main field of expertise, he serves as a member of the editorial board for the scientific journal *Computers and Electronics in Agriculture* (Elsevier). He is currently an integrated member of the Centre for Research and Agro-Environmental and Biological Technologies (CITAB) and a collaborative member of the Institute for Systems and Computer Engineering in Porto (INESC TEC). He has been involved in more than 11 international projects and is currently the coordinator at UTAD for the Mobilizing Agenda Vine & Wine PTT under the PRR, as well as the coordinator of the POCTEP/INTERREG V project “SIAPD - Integrated Transregional System for Supporting the Fight Against Pests and Diseases in Agriculture.