Grant TED2021-132356B-I00 funded by MCIN/AEI/10.13039/501100011033 and by the "European Union NextGenerationEU/PRTR"

14th- 16th November 2023 – León (SPAIN)

PROGRAMME

International Autumn School on Artificial Intelligence and Robotics for Sustainable Agricultural Systems

SAIRSAS 2023

https://shepherd-robot.github.io/sairsas.github.io/

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WELCOME

The International Autumn School on AI and Robotics for Sustainable Agricultural Systems (SAIRSAS 2023) aims to provide the right environment to discuss developments in agriculture through the use of new technologies such as artificial intelligence and robotics. This first international meeting organised by the Robotics Group aims to bring together professionals, researchers and students interested in applying artificial intelligence-based solutions in precision livestock farming. In this way, multidisciplinary collaborations and synergies between such diverse fields can be achieved, making it possible to reach innovative and relevant solutions for society.

We thank all the participants for their attendance to the Autumn School and for their contribution to create synergies among these multidisciplinary topics in order to help with the transference of knowledge from the University to the society. In addition, we truly appreciate the keynote speakers for sharing their knowledge and their availability to come to León. The members of the Organizing Committee have endeavoured to offer a programme that provides an enriching experience for all attendees, including academic talks and social activities.

We want to express our special gratitude to the sponsors of the event: thanks to the University of León for their financial support for the organization of this autumn school; thanks also to the Robotics research group and to the research project with grant Grant TED2021-132356B-I00 funded by MCIN/AEI/10.13039/501100011033 and by the "European Union NextGenerationEU/PRTR". Finally, we would like to thank the Granja Experimental of the University of León, Facultad de Veterinaria, Universidad Rey Juan Carlos, Agrovet Laboratorios Analíticos, Precision Drone (Drone Engineering Solutions) and MENDEA Ingeniería Ambiental for their support.

All of you have made this possible.

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ORGANIZING COMMITTEE

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SCHEDULE

	Martes 14 noviembre	Miércoles 15 de noviembre	Jueves 16 de noviembre
	Outdoor Navigation	**Computer vision in agriculture**	**Field Tests**
9:00-9:30	Registration	Registration	Registration
9:30-10:30	Opening	Keynote Beatriz Remeseiro	Visit to Granja Experimental ULE
10:30-11:30	Keynote Aamir Ahmad	Keynote Pablo Bustos	
11:30-12:00	Coffee break	Coffee break	Visit to Robotics Group Lab
12:00-13:00	Keynote José M. Guerrero	Keynote Georgios Ouzonis	Visit to AGROVET
13:00-15:00	Lunch	Lunch	Lunch
15:30-16:30	Keynote Luis Emmi	Computer vision applications in agriculture and livestock precision farming	
16:30-17:00	Coffee break	Coffee break	
17:00-18:00	Keynote Francisco Martín	Group work focused on current projects and future calls	
18:00-19:00	Free time	Free time	
19:30	León Walking Tour	León Walking Tour	
20:30	Dinner	Gala dinner	

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KEYNOTE SPEAKERS

Aamir Ahmad

Dr. Aamir Ahmad, a distinguished researcher and academic, serves as the leader of the Flight Robotics and Perception group (FRPG) at the University of Stuttgart. He holds the esteemed position of Tenure-Track Professor, where he occupies the chair of "Flugrobotik" (Flight Robotics) and fulfills the role of Deputy Director (Research) at the Institute for Flight Mechanics and Controls within the Faculty of Aerospace Engineering and Geodesy at the University of Stuttgart, Germany. Additionally, Aamir holds the position of Research Group Leader at the Perceiving Systems department of the renowned Max Planck Institute (MPI) for Intelligent Systems in Tübingen, Germany. His expertise in the field of Flight Robotics and Perception has earned him recognition as a driving force in the advancement of intelligent systems and cutting-edge research in this domain.

Title: ***Intelligent Aerial Robots for biodiversity conservation***

Abstract: *Some of the most pertinent societal problems today include i) biodiversity monitoring over huge spatio-temporal scales to empirically quantify the impact of climate change, ii) search-and-rescue in the aftermath of natural disasters, and iii) large-scale sustainable agriculture. The spatial and temporal scales combined with different levels of resolution required to address these challenges make them particularly difficult. For example, position of animals need to be monitored over hundreds of kilometers and for several months to understand their migratory patterns. Low-resolution position estimates of the animals will suffice in this case. However, to understand an individual's behavior, a high-resolution estimate of the animal's pose may be required. In this talk, I will elaborate on how my research on intelligent aerial robots aims to address such challenges. I will discuss how vision-based active perception in aerial robotic systems is key to solving these problems. In particular, first, I will present novel methods based on both classical and deep-learning for human pose and animal behavior estimation from a team of autonomous aerial robots. Second, I will discuss the novel aerial robots we have developed to*

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address further practical and logistic challenges involved in real-world deployment. Third, I will describe our ongoing, large-scale, animal conservation-related project. Finally, I will highlight many of our real-world experiments and demonstrations.

José M. Guerrero

Dr. José Miguel Guerrero Hernández received his Bachelor's Degree, Master's Degree, and Doctorate in Computer Science from the Complutense University of Madrid (UCM) in 2008, 2010, and 2015. He has been a predoctoral fellow of the training research program at the UCM (2011-2013) and subprogram university lecturer (FPU) at the MECD (2013-2015), postdoctoral research assistant at UCM (2015-2017), UNED (2017-2018) and CIEMAT (2018-2019), and Associate Professor at King Juan Carlos University (2019-present). He graduated with honors and has received multiple grants and awards. His research focused on the development of new multisensory fusion techniques for Vision Systems applied to Precision Agriculture, Marine Navigation, Social Robots, and Robotics, Vision, Safety, and Navigation in indoor environments, among others.

Title: ***Computer vision for cropping***

Abstract: *The vision system installed on an autonomous tractor as part of the RHEA project (Robot Fleets for Highly Effective Agriculture and Forestry Management) is introduced. This system incorporates various artificial vision techniques designed for real-time identification of crop rows and weeds in a cornfield. The focus of this research is on the precise detection of crop rows, enabling the tractor to achieve reliable guidance without relying on global positioning systems (GPS). This advancement is crucial to prevent crop damage and unwanted overlap in treatment areas. Within the context of this work, a detailed explanation of how the crop rows are identified and the process ensuring the tractor stays on the correct path will be provided. Furthermore, the prototype of the installed system will be presented, along with details of the tests conducted in a real field environment. This advancement in vision technology represents a significant milestone in agricultural automation and has the potential to substantially enhance efficiency and sustainability in crop management.*

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Luis Emmi

Luis Emmi is a post-doc researcher in the Field & Service Robotics Group, at the Centre For Automation and Robotics (UPM-CSIC), in Madrid, Spain. His research is focused on navigation strategies of mobile robots in semi-structured environments; vehicle control architectures; topological maps, sensor fusion and IoT; computer-vision based on artificial intelligence; and fleets of robots. These activities are carried out within the project titled "Sustainable Weed Management in Agriculture with Laser-based Autonomous Tools (WeLASER, H2020 101000256, 2020-2023)". He received the B.E. degree in Electronic Engineering from the Simón Bolívar University, Caracas (Venezuela) in 2008. The M.E. degree in Computer Science with specialization in Engineering for Industry and PhD degree in Computer Engineering (with mention of European doctorate) were received from the University Complutense of Madrid (UCM), in 2011 and 2014, respectively.

Title: ***Intelligent controllers and autonomous navigation in agricultural environments WeLASER project case study***

Abstract: *Intelligent controllers and autonomous navigation systems are promoting the inclusion of robotic systems in agriculture, redefining the way that crop management, yield optimization, and resource utilization are executed. This presentation explores the integration of intelligent controllers and autonomous navigation emphasizing their potential to enhance reliability, efficiency, sustainability, and productivity. Intelligent controllers, often based on Artificial Intelligence and Machine Learning, offer data-driven decision-making capabilities that enable real-time assessment of crop status, pest infestations, and environmental conditions. This presentation also addresses the inclusion of intelligent controllers and autonomous navigation capabilities in the WeLASER mobile platform. The project "Sustainable Weed Management in Agriculture with Laser-based Autonomous Tools (WeLASER)", funded by the European Union's Horizon 2020 research and innovation program under grant agreement No 101000256, aims to merge current technologies to build, assess and push into the market a precision weeding equipment based on high-power laser sources and autonomous mobile systems with the main objective of eliminating the use of herbicides while improving productivity and competitiveness.*

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Beatriz Remeseiro

Dra. Beatriz Remeseiro, received the PhD degree "Cum Laude with International Honors" in Computer Science for her work on medical image analysis in 2014, at the University of A Coruña (Spain). Her PhD thesis was honored with the "2nd Award to the Best PhD Thesis 2014" from the Spanish Association for Artificial Intelligence, and with the "Gradiant Award to the best PhD Thesis applied to ICT 2016" from the Galician Official College and Association of Telecommunications Engineering. After two postdoctoral fellowships from 2015 to 2017, at the INESC TEC (Portugal) and the University of Barcelona (Spain), she is currently an Associate Professor at the University of Oviedo (Spain). Her main research interests include computer vision and deep learning, mainly applied to real-world problems in areas such as medicine or industry.

Title: ***Semantic segmentation: overview and applications to agriculture***

Abstract: *Semantic segmentation is a cutting-edge computer vision technique that involves the assignment of a label to every pixel in an image, categorizing each pixel to represent the object or class it belongs to. Over the last few years, it has found numerous applications across various domains, including agriculture. In this presentation, we will provide an in-depth overview of semantic segmentation, its fundamental principles, and some state-of-the-art deep learning methods used in the field. We will also discuss the challenges and opportunities in implementing semantic segmentation for problems such as crop monitoring or disease detection, showcasing real-world examples that can revolutionize the agricultural sector by increasing efficiency, sustainability, and productivity.*

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Pablo Bustos

Pablo Bustos is a professor of the University of Extremadura (UEx) in the area of Computer and Communications Technology, coordinator of the UEx Research Laboratory in Robotics and Artificial Vision, RoboLab, and deputy director of the UEx's INDEHESA Institute dedicated to the research of «dehesas» as multifunctional ecosystems. Professor Bustos holds a degree in Computer Science from the Universidad Politécnica de Madrid and obtained his PhD in Artificial Intelligence from the same university in 1999. For ten years he worked as a researcher in intelligent autonomous robots at the Industrial Automation Institute of the Consejo Superior de Investigaciones Científicas (CSIC) in Arganda del Rey, Madrid, from which he moved to the University of Extremadura in 2001. He set up, together with other professors RoboLab, that has pursued an intense research and training activity since its inception. He has participated in over 35 research projects in Robotics, directing 15 of them and has published more than 115 contributions in international journals and conferences. His research interests include the design of autonomous robots, cognitive architectures for Robotics, Artificial Vision, cyber-physical systems applied to agriculture and livestock, the Internet of Things and free software.

Georgios Ouzonis

Georgios K. Ouzounis is the Head of ML Engineering at AtlasAI. He is the inventor of three algorithms, the dual-input Max-Tree algorithm, the one-pass method for computing Differential Area Profiles by Area Zone Decomposition, the Alpha-Tree and the Extended Connectivity Tree algorithm. His works include innovative protocols for fusing hierarchical image representation data structures with deep learning algorithms for unsupervised and real-time object detection.

Title: ***Atlas of Human Settlements: a use case in monitoring infrastructure***

Abstract: *The Atlas of Human Settlements is a built-up basemap of global coverage, delivered at 10m spatial resolution and updated annually, with legacy layers since 2016. It consists of a number of semantic layers imprinting*

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key attributes describing settlement extent and fabric. Using state-of-the-art AI and open-access data we transform these features into actionable socioeconomic indicators such as the asset wealth index and the spending power index, or use them in advanced data science workflows that present us with insights into the living conditions, health, demographics, transportation patterns, economic activity, development trends and more. These are key indicators allowing us to sketch the greater picture and get a more holistic view of any habituated environment across the world. AHS powers many different applications and finds extensive use in monitoring supply chains. Extending this to the agricultural sector, it can be seen as an instrument reporting the presence and sufficiency of storage facilities and processing plants, while forecasting infrastructure demand for the immediate future. Paired with recommender systems it helps identify optimal locations for new investment with an interest in improving the farmer to seller process while minimizing transportation time and cost, and associated carbon emissions. This talk will focus on the core AHS layers and services, demonstrate uses in monitoring supply chain infrastructure and further discuss extensions to the agricultural sector.

Francisco Martín Rico

Francisco Martín is Professor at the Universidad Rey Juan Carlos, where he leads the Intelligent Robotics Lab. He teaches subjects such as Software Architectures for Robots, and Planning and Cognitive Systems. He is the author of the book "A Concisse Introduction to Robot Programming with ROS 2" and is a member of the ROS 2 Technical Steering Committee. He is the author of PlanSys2, the symbolic planning reference software for ROS 2, and is a contributor to other reference packages such as rclcpp, Behavior Trees and Nav2. He is currently involved in several European and national projects, as his group is an international reference in ROS 2, navigation for mobile robots and planning. He was awarded in 2022 with the Best ROS Developer award at the ROS Developer Day and is a member of the ROS 2 TSC.

Title: NAV2: concepts, design, and adaptation to outdoor environments
Abstract: *Navigation is one of the fundamental capabilities of a mobile robot, having been the subject of studies for many decades. Still, few frameworks survive a concrete robot, a specific laboratory, or the project/paper for which it was developed.*

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With the advent of ROS over a decade ago, Move Base, and now with ROS 2, Nav2, have established frameworks that standardize a solution for navigation applicable to all types of robots. In this talk, we will see the design fundamentals and main concepts of Nav2, and we will take a tour of its real use in indoor and outdoor environments through our projects, experiments, and papers.

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LOCAL INFORMATION

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The City of León

Leon's origins go back to the times when the Romans dominated Hispania; and parts of the Roman walls and other monuments of the period can still be seen. The city took on a new prominence in Spain's history in the first centuries of the Reconquest. The city was a bastion for the fledgling kingdom of Asturias in the war with the Moorish invaders, and soon became the capital of its own kingdom, The Kingdom of Leon. A constant succession of wars and courtly intrigues formed the background to a turbulent period in which the Leonese monarchy extended its domains southwards, establishing the foundations for the construction of Spain.

A story written in blood and fire that took place alongside the development of the arts and sciences in the city, shown in the wealth of monuments and buildings of the period: shining examples of Romanesque art and architecture, such as the Basilica of San Isidoro, Gothic masterpieces such as the Cathedral de Santa María and wonderful examples of the Renaissance such as the Convento de San Marcos define the city and combine with aristocratic town houses, churches and convents in beautiful urban settings such as the Plaza Mayor. Modern Leon (150,000 inhabitants) is spread out over large spacious avenues that make it a very relaxed and human city that reflects the easy-going character of the locals. Leon is also remarkable for having more than a million square metres of green spaces in the form of large parks and small gardens, ideal for relaxing and a leisurely walk.

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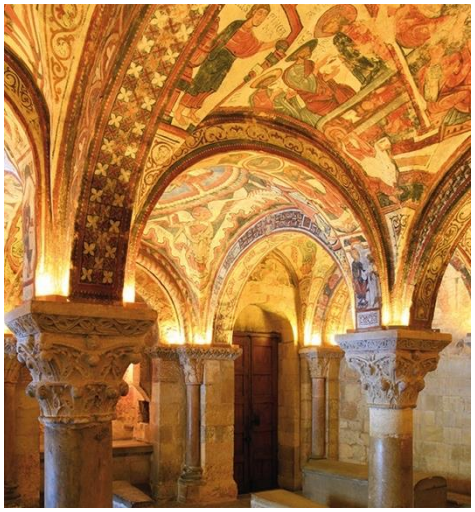

In the old quarter of the city, the plazas and narrow streets of the Barrio Húmedo are teeming with bars and restaurants. The district is a place where visitors can mix with the locals and sample the delicious local cuisine. The city is full of life throughout the year. There are events and festivals for all tastes: traditional, religious, sports and culture: from Holy Week to the Fiestas de San Froilán, International Trout Week and culinary competition, or the International Organ Festival, to name just a few of the most traditional events.

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VENUE

The autumn school will be held in Sala de Conferencias de la Biblioteca San Isidoro.

Sala de Conferencias de la Biblioteca San Isidoro
Campus de Vegazana, 24071, León

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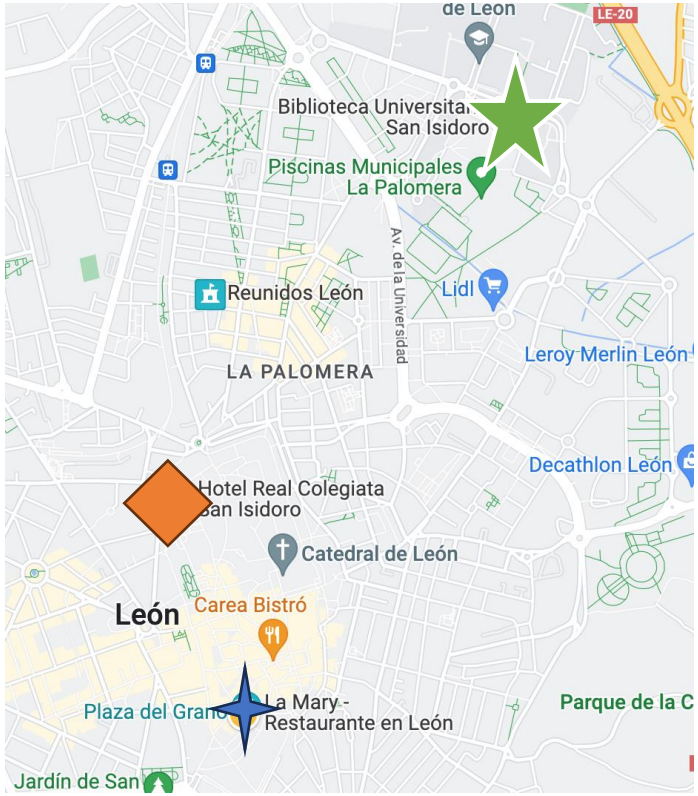
VENUE PLANS



Conferences: Biblioteca de San Isidoro

Restaurante La Mary

Restaurante Colegiata San Isidoro

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REGISTRATION AND PLENARIES

Date: 14th and 15th, Sala de Conferencias. Biblioteca de San Isidoro. Universidad de León. Campus de Vegazana

MEALS

Date: 14th - TUESDAY, Time: 13:00	*Cafetería Universitaria.* Universidad de León. Campus de Vegazana
Date: 15th - WEDNESDAY, Time: 13:00	*Cafetería Universitaria.* Universidad de León. Campus de Vegazana
Date: 16th – THRUSDAY, Time: 14:00	*Agrovet*

DINNERS

Date: 14th - TUESDAY, Time: 21:30	*La Mary Restaurante (Plaza Don Gutierre)*
Date: 15th - WEDNE*SDAY, Time: 21:00*	*Restaurante Colegiata San Isidoro (Plaza Santo Martino)*

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VISITS

Date: 16th – *THRUSDAY* 9:30h Visit to Granja Experimental de la Universidad de León

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Date: 16th – *THRUSDAY* 12:00h Visit to AGROVET

Camino Caserío Santovenia, 24217 Mansilla Mayor, León

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Useful phone numbers

The international phone number prefix for Spain is +34

Emergency call number (preferred)	112
Police	091
Ambulance	061
Fire brigade	080

Emergency contact: **+34 630641876 (Lidia)**

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