



# Exceptional 36-months Double Degree PhD Scholarship

Position-F  
Cotutelle PhD degree, Mechanical Engineering from IST and  
Computer Science from Univ Toulouse

***Optimized Olive crop irrigation based on high quality soil data using IoT networks***

EU Recruiting institutions	IST - Instituto Superior Técnico, Universidade de Lisboa, Portugal (24 Months), Supervisor: Rui Coelho, Jorge Martins, Alice Teixeira Université Toulouse Capitole, IRIT – Institut de Recherche en Informatique de Toulouse, Toulouse, France (12 Months), Supervisor: J. Aligon, R. Tournier, Moncef Garouani, Olivier Teste, Franck Ravat.
Keywords	Data Science, ML & AI, AI Explainability (XAI), Digital Agriculture, Remote Sensing (IoT and IoRT), Sustainability, Impact assessment, Decision Support Systems

## Exceptional benefits at a glance

- ***International PhD training excellence*** ([here](#))
- ***Renowned supervisors & top-tier labs***
- ***Interdisciplinary & multi sectoral research***
- ***Competitive MSCA salary & allowances***
- ***Global academic & industrial network***
- ***Non-academic secondments***

### Salary

	Living Allowance	Mobility Allowance*	Family Allowance**
<b>Gross amount</b>	EUR 45088 ( per year)	EUR 710 per month	EUR 660 per month

### Long Term leave allowance (if applicable)

### Special needs allowance (if applicable)

\*private mobility-related costs (e.g. travel and accommodation costs), not their professional costs under the action

\*\*doctoral candidate has or acquires family obligations during the action duration, i.e. persons linked to him/her by (i) marriage, or (ii) a relationship with equivalent status to a marriage recognised by the legislation of the country or region where this relationship was formalised; or (iii) dependent children who are actually being maintained by the researcher, the family allowance must be paid to him/her as well

## GreenFieldData Project at glance

**GreenFieldData:** “IoRT Data management and analysis for Sustainable Agriculture” is a project funded under the action HORIZON Marie Skłodowska-Curie Action (MSCA) Joint Doctoral Network. **GreenFieldData** will train a new generation of researchers able to tackle digital and green transition challenges using a human-centric approach to ensure the robustness and relevance of the solutions

responding to the specific needs of the EU market in a context of climate change and increasing socio-economic constraints. At a policy level, **GreenFieldData** outcomes will feed in directly to the aims of the HE Strategic Plan 2025-2027, EU Partnership Agriculture of Data and Digital EU Program. **GreenFieldData** proposes a high-level interdisciplinary, inter-sectoral and international (triple 'i') research project and training network on new IoRT (Internet of Robotic Things) based solutions for sustainable agriculture. **GreenFieldData** will mobilize 14 Doctoral Candidates (DCs) enrolled in Double Degree Doctorate programmes with 12 academic main beneficiary partners, across 7 EU countries. Moreover, 21 non-academic associated partners, and 3 academic associated partners will provide support to the DCs. The partners form a high quality network, where Academic partners have previous research collaborations as outlined in a common vision paper. The ambitious project will provide the DCs with a unique toolbox of cutting-edge knowledge, tools and strategies which will boost their employability and benefit the next generation operational workforce (researchers, Digital Technologies (DTs) and agricultural stakeholders). The project results will also benefit EU innovation as the human-centric IoT devices & robotics, and data-based solutions tailored to EU context will enable the agricultural sector to assess and mitigate the impacts of climate change, and define new sustainable low input practices, thus increasing resilience and competitiveness.

## **PhD Position F – Optimize Olive crop irrigation based on high quality soil water data availability using IoRT networks**

**Context:** Due to a traditional adaptive capacity to face droughts, current olive groves represent the largest irrigated area in Portugal, with about 374,762 hectares (Ha) cultivated for olive oil production (INE, 2020), making Portugal the 5th largest exporter in the world. About 75% of this area, is in the Alentejo region (southern Portugal). Together with almond (2nd largest irrigated crop in the Alentejo) they occupy extensive continuous areas and play a crucial role in the economic and social development of rural areas in southern Portugal. However, these crops are facing challenges due to climate change. Considering the future scenarios for the Alentejo - droughts are expected to be more severe and numerous (about 3 major droughts every 5 years) - ensuring a sustainable water resource management in this territory is essential.

In the Iberian Peninsula, the traditional method of growing olive trees "in canopy" has been replaced by the super-intensive "hedgerow" system. This system has been the basis of the modernization in olive groves (such as increased mechanization and optimized crop cycles) and associated increase of olive oil. To maintain current production levels and the market for this Alentejo crop, producers are looking for advancements in sustainable irrigation practices that are both environmentally and economically viable.

**Current approaches and research questions:** Current approaches rely, on one side, on data gathered from fixed sensor stations, drone flyover, or satellite imagery. However, data from these sensors has issues, low resolution for satellite imagery, obstruction from tree canopy for drone flyover and very localized measures for fixed stations. And on the other side, the increasing efficiency of machine learning algorithms (AI) has brought new technological solutions for decision support systems. However, those systems propose decisions with very little justification or explanations as to why the algorithms have come up with such decisions.

For example, and among other things, unsupervised learning techniques have proven to be highly effective, particularly clustering methods. Clustering allows similar elements to be grouped together to reveal hidden structures in complex data sets, while also enabling atypical behaviors to be identified [1]. However, the need to understand what may have led to the composition of clusters remains a major and ongoing challenge (i.e., XAI, explainable AI). Although some works have been done in this area, the equivalent of a method that is both user-friendly and simple, such as the SHAP method [2] for supervised learning,

remains to be explored.

Moreover, traditional clustering methods such as k-means, DBSCAN, etc., are often sensitive to the problem of sparse data, which is accentuated when the data is high-dimensional. To overcome this, subspace clustering methods [3] have been proposed in the literature. These methods are designed to group data into homogeneous subgroups, while determining, for each group, the relevant subspaces of variables that characterize it. Even though the results in the literature show better performance in the case of sparse data, it can be difficult to understand the reasons why the subspaces were constructed. Therefore, a method of explanation is necessary for a good understanding of the generated subspaces and the links between them.

**Objectives:** This research will use a previously developed autonomous ground scouting robot (EVAbot—Environmental Agricultural robot), that can continuously monitor with high precision soil, weeds and olive trees, close to the ground such as the space along the tree-line ridge and in between the tree-lines in hedgerows [4]. Onboard sensors will also provide continuous meteorological data and measure each tree's vegetation and soil health, using, among others, multispectral imagery. This will provide high resolution detailed data. Using this data, decision support algorithms will provide

The detailed objectives are the following:

1. From data collected on soil humidity, and other measurements associated (such as of organic matter, soil pH or vegetation growth) from existing systems, machine learning (ML) models will be used to help decision-making in irrigation management (**Project tasks: 1.1, 1.2, 1.3**).
2. Understand the farming factors that influence selected the ML models, via explanation methods ("explainability", XAI) (**Project tasks: 2.1**).
3. Convert this into decision processes by analyzing how predictions and explanations can be sources of reliable information to help carry out actions in efficient water management (Actionable XAI) (**Project tasks: 3.1, 3.2**).
4. Provide information for improved decisions to optimize water resources using and adapting to changing environmental conditions (**Project tasks: 4.1, 4.2, 5.1**).

Compared to existing methods, this work will analyze how the increase in multidimensional, multi-scale and multi-modal data availability and quantity, influence supervised or unsupervised machine learning models both outputs and explainability. Moreover, how these outputs (prediction, decision, classification, associated explanations, etc.) would either interfere with farmers' decision processes or influence farming management.

Combining Robotics and AI approaches will elevate Precision Agriculture to a new level of Precision (the level of each specific tree) while at the same time, it will reduce and convert demands of human resources to an increased technical level.

**Work plan:** objectives will be achieved by working in a dual research environment in Portugal and France.

1. Conduct a literature review on AI explainability and notably machine learning (ML) models.
2. Familiarize with the available data [collected during months 5 – 15] and how to characterize them, analyze required preprocessing steps. This will be done in association with other Phds that will collaborate and provide help with the EVAbot and its sensors.
3. Select candidate ML models.
4. Train ML models, explore outputs to characterize explainability and experiment within the secondegment framework and datasets; validate experiments.

## Expected Results

1. A system for integrating multi scale data (soil, tree, overall field measurements, etc.) in an XAI process pipeline.
2. New methods for measuring the impact of combining multi-resolution data (in scale, availability and quantity/frequency).
3. A framework allowing comparisons between algorithmic decision support outputs with irrigation management decisions.
4. Additional sensors on the existing EVAbot system for data acquisition (the hardware is implemented in collaboration with Master students from Instituto Superior Técnico).
5. Updated database with field continuous time/spatial data and irrigation data.

## References

- [1] Jinbo Li, Hesam Izakian, Witold Pedrycz, Iqbal Jamal, Clustering-based anomaly detection in multivariate time series data, *Applied Soft Computing*, 2021
- [2] Lundberg, Scott M and Lee, Su-In, A Unified Approach to Interpreting Model Predictions, *Advances in Neural Information Processing Systems*, 2017
- [3] Jianyu Miao, Xiaochan Zhang, Tiejun Yang, Chao Fan, Yingjie Tian, Yong Shi, Mingliang Xu, A Comprehensive Survey on Subspace Clustering: Methods and Applications, *Artificial Intelligence Review*, 2025
- [4] Robotics4Farmers PRR project: <https://robotics4farmers.tecnico.ulisboa.pt/>

## PRACTICAL INFORMATION

### Recruiting and host institutions

- IST - Instituto Superior Técnico, Universidade de Lisboa, Portugal (24 months) ([Recruiting institution](#))

### Doctoral schools

- Técnico Doctoral School @ IST - Instituto Superior Técnico, University of Lisbon, Portugal
- MITT @ Université de Toulouse, France

### Supervisors

- Dr. Rui Coelho, Dr. Jorge Martins (Instituto Superior Técnico, Lisbon, Portugal)
- Dr. Ronan Tournier, Dr. Julien Aligon (Université Toulouse Capitole, Toulouse, France)

### Non-academic mentors

- José Falcão (Torre das Figueiras - Sociedade Agrícola, Lda, Portugal)
- Damien Appert (Neusta, France)

### Secondments (1 to 6 hosting months)

- Torre das Figueiras - Sociedade Agrícola, Lda, Portugal. 1 week per month (months 7 – 15). Collect data and observe water stress and irrigation periods.
- Neusta, Toulouse, France. Months 20-22, experiments with different agroforestry datasets.

### Contact information

- [rui.coelho@tecnico.ulisboa.pt](mailto:rui.coelho@tecnico.ulisboa.pt); [jorgemartins@tecnico.ulisboa.pt](mailto:jorgemartins@tecnico.ulisboa.pt)
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## RECRUITMENT CRITERIA

### General criteria

- MSCA Mobility Rule: researchers must not have resided or carried out their main activity (work, studies, etc.) in **Portugal** for more than 12 months in the 36 months immediately before their date of recruitment
- All researchers recruited in a DN must be doctoral candidates (i.e. not already in possession of a doctoral degree at the date of the recruitment)
- An applicant must have received the equivalent of 300 ECTS with a major in computer science, from which at least 60 ECTS corresponds to a master degree. The master degree must be granted by a university recognized by the International Association of Universities.
- Scientific excellence to fit the PhD project
- Fluent (oral and written) English skills as the project operates in English language
- Knowledge of the language of the host country may be considered a merit
- Team-mindedness

## Required skills

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- Good programming skills
- Knowledge in machine learning
- Advanced database notions is a plus
- Knowledge of robotics and environmental sensors (IoRT) is a plus
- Interdisciplinary work
- Master degree (or equivalent)

## APPLICATION

### How to apply?

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- All information are provided [here](#)

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**Deadline: 15th April 2026**

## Other information

### Université de Toulouse

The **Université de Toulouse (Univ Toulouse)** is a large, public research university system based in Toulouse, France, and one of the oldest in Europe, originally founded in **1229**.

- **Structure:** While historically a single entity, the modern University of Toulouse is a collective entity (a *Communauté d'universités et établissements* or *ComUE*) that federates several autonomous universities and institutions of higher education in the Toulouse region, including:
  - **Toulouse 1 Capitole University** (Law, Economics, Management),
  - **University of Toulouse - Jean Jaurès** (Arts, Literature, Languages, Humanities, Social Sciences),
  - **Toulouse III - Paul Sabatier University** (Sciences, Health, Sport).
- **Scale and Focus:** It is a major university area in France, educating over **100,000 students** across a wide spectrum of disciplines, including aerospace, computer science, health, and social sciences.

## IRIT: Toulouse Research Institute in Information Technology

The **Institut de Recherche en Informatique de Toulouse (IRIT)** is a highly influential **Joint Research Unit (UMR 5505)** in France, dedicated to **Information Technology (IT)** and **Computer Science**.

- **Nature:** It is one of the largest and most significant research laboratories in the field in the Occitanie region and nationally.
- **Supervision (Multi-Tutelle):** It operates under the joint supervision of several major institutions, including the **CNRS** (French National Center for Scientific Research) and the various Universities of Toulouse (Toulouse INP, UT Capitole, UT Jean Jaurès, and UT Paul Sabatier).
- **Focus Areas:** IRIT's research covers a broad range of core IT topics, structured around key scientific themes and strategic application domains.
  - **Scientific Topics** include the design and construction of systems, numerical modeling of the real world, concepts for cognition and interaction, autonomous adaptive systems, and transforming raw data into intelligible information.
  - **Strategic Applications** include Health, Autonomous Systems, and Well-being; Smart Cities; Aeronautics, Space, and Transportation; and Digital Social Ecosystems (Social Media).
- **Size:** It comprises a large team of hundreds of researchers, faculty, and PhD students.

## Instituto Superior Técnico (IST), University of Lisbon

**Instituto Superior Técnico (IST)**, often known as **Técnico Lisboa**, is the largest and most prestigious school of engineering, science, and technology in Portugal. Established in **1911**, it is an integral part of the **University of Lisbon (UL)** and is consistently ranked among the top engineering schools in Europe.

IST is dedicated to providing high-quality education, promoting research, development, and innovation, and extending its services to the community.

- **Broad Academic Offer:** IST offers a wide range of academic programs, including **Bachelor's (Licenciatura)**, **Master's**, and **Doctoral (PhD)** degrees across diverse fields of engineering—such as Civil, Mechanical, Electrical, Computer, and Aerospace—along with pure sciences, including Mathematics, Physics, and Chemistry.
- **Research Excellence:** The institution is a powerhouse of **multidisciplinary research**, hosting numerous R&D centers and participating in various international consortia. It plays a pivotal role in advancing scientific and technological knowledge across Portugal and beyond.
- **International Profile:** IST maintains strong international connections through student and staff mobility programs (like **Erasmus+**), research collaborations, and joint degree programs with prestigious universities worldwide, fostering a global learning environment.
- **Campuses:** It operates three main campuses: the historic **Alameda campus** in the heart of Lisbon, the **Taguspark campus** located in Oeiras (a technology hub), and the **Saldanha campus** (offering executive training).

Técnico offers its community a wide range of cultural, ludic, and sport activities. Student organisations and student clubs at Técnico promote the academic spirit, which contributes to full integration of students into the school's life. Complete information may be obtained [here](#).