Funded by the European Union

Marie Skłodowska-Curie Actions

Green Field Data

Exceptional
36-months Double Degree PhD Scholarship
Position-G

Phd in Computer Science for UCD
and Sciences and technologies in agriculture, food science and environment from INRAE

Characterization of abiotic stress of trees using AI methods on acoustic signals

EU Recruiting institutions	University College Dublin, National University of Ireland, Dublin, Ireland (18 Months), Supervisor: Prof. Tahar Kechadi INRAE - University Clermont Auvergne, Clermont-Ferrand, France (18 Months), Supervisor: Dr. Guillaume Charrier
Keywords	Data Science, ML & AI, Digital Agriculture, Remote Sensing (IoT and IoRT), Data quality, IoRT Network performance, Hybrid communication system

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**
Gross amount	**EUR 5470**	**EUR 710**	**EUR 660**

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 Sklodowska-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 G – Characterization of abiotic stress of trees using AI methods on acoustic signals

Context: Abiotic stresses (e.g. frost, drought, wind) cause significant damage to natural and cultivated plants, which is expected to increase in the future with increasing climate variability (extreme climatic events). The detection of acoustic emissions is a promising way to measure continuously and non-invasively the damage affecting plants. Different sources of acoustic emissions have been identified (e.g. air bubble formation in conductive tissues, cell lysis, mechanical rupture, see references below) generating acoustic signals with their own characteristics. The analysis of the waveforms (amplitude, frequency, etc.) allows them to be discriminated under single stress conditions. However, to date, no study on a set of stresses (succession or interaction) has been carried out, and since plants are permanently subjected to different stresses, the use of this technique remains limited (in time, e.g. period of water stress, or in space, e.g. altitudinal limit). This case study therefore aims to better characterize the acoustic emissions generated by a single constraint and by their interactions, in order to ultimately develop a tool capable of measuring damage under natural conditions.

Objectives:

This case study will focus on two complementary parts: (i) analysis of acoustic signals to extract relevant information from it (signal quality), (ii) comparison of classified acoustic measurements with ecophysiological reference measurements in cultivated sites with different stress modalities (e.g. agroecological orchards and vineyards along natural gradients).

The characterization of the acoustic signature will make it possible to measure the damage generated by different climatic hazards and to better understand the physiological mechanisms of resistance to abiotic constraints. The acoustic signature, integrated into the algorithm controlling the autonomous acoustic sensors, will make it possible to trigger alerts and an adapted response to these different climatic constraints. The design of a tool capable of measuring damage and, ideally, mitigating its consequences before it becomes irreversible is key to mitigate consequences of climatic stress. By providing a better understanding of the physiological mechanisms that plants develop to resist abiotic stress and, above all, their interactions, it fits to the challenge agroforestry and agro-ecology will face in the future.

. All the mentioned objectives can be listed as follow:

1. Investigate the potential of using acoustic emissions to detect and measure damage caused by abiotic stresses (drought, frost, etc.) in plants;
2. Develop a non-invasive method for continuous plant health monitoring based on reliable acoustic

signatures;
3. Analyse the unique acoustic signatures of different abiotic stresses on plants by means of advanced analytics methods.

This is a novel approach as previous research focused on single stresses, while in nature plants experience multiple or interacting stresses. These objectives will be achieved using the following work planning to grant their feasibility.

Work plan:

1. Conduct a literature review in data collection techniques used to collect the data for this project and ML techniques for multimodal datasets [Month 1 – 6].
2. Attend training on database of acoustic signals, applied stress and physiological indices collected in different woody species under drought and frost stress. [Month 3 – 6].
3. Explore the diversity of signals and perform complementary experiments to finalize the training dataset [Month 6 – 12].
4. Develop a data analysis process based on machine learning for multimodal datasets and evaluate its performance and robustness of it results [12 – 24].
5. Develop and implement an intelligent acoustic system and validate its results in the field (real-world data). [Month 24 – 33]

Expected Results

1. Ability to detect acoustic signals and measure damage caused by different climate hazards on plants in controlled conditions;
2. AI methods for collecting large, representative, high-quality acoustic datasets over time;
3. AI methods for removing noise and outliers from the data;
4. AI methods for extracting key features from multi-modal data;
5. AI assisted monitoring of damages in the field.

References

- Charrier G., Charra-Vaskou K., Legros B., Améglio T., Mayr S. (2014a) Changes in ultrasound velocity and attenuation indicate freezing of xylem sap. *Agricultural and Forest Meteorology* 185, 20-25.
- Charrier G., Charra-Vaskou K., Kasuga J., Cochard H., Mayr S., Améglio T. (2014b) Freeze-thaw stress: Effects of temperature on hydraulic conductivity and ultrasonic activity in ten woody angiosperms. *Plant Physiology* 164, 992-998.
- Charrier G., Pramsohler M., Charra-Vaskou K., Saudreau M., Améglio T., Neuner G., Mayr S. (2015) Ultrasonic emissions during ice nucleation and propagation in plant xylem. *New Phytologist* 207, 570–578
- Charrier G., Nolf M., Leitinger G., Charra-Vaskou K., Losso A., Tappeiner U., Améglio T., Mayr S. (2017) Monitoring of freezing dynamics in trees: a simple phase shift causes complexity. Plant Physiology 173, 2196-2207
- Kasuga J., Charrier G., Uemura M., Améglio T. (2015) Characteristics of ultrasonic acoustic emissions from walnut branches during freeze–thaw-induced embolism formation. *Journal of Experimental Botany* 66, 1965-1975.
- Lamacque, L., Sabin, F., Améglio, T., Herbette, S., & Charrier, G. (2022). Detection of acoustic events in lavender for measuring xylem vulnerability to embolism and cellular damage. *Journal of Experimental Botany*, *73*(11), 3699-3710.
- N. Chergui and M-T. Kechadi, “Data analytics for crop management: a big data view”, Journal of Big Data, 9(1), 2022, https://doi.org/10.1186/s40537-022-00668-2
- Bansal, Y., Lillis, D. and Kechadi, M-T. A neural meta model for predicting winter wheat crop yield. Mach Learn 113, 3771–3788 (2024). https://doi.org/10.1007/s10994-023-06455-1
- Ngo, Vuong and Kechadi, M-T., “Electronic Farming Records - A Framework for Normalising Agronomic Knowledge Discovery”, Journal of Computers and Electronics in Agriculture, 184(01), May 2021. http://doi.org/10.1016/j.compag.2021.106074

PRACTICAL INFORMATION

Recruiting and host institutions	• University College Dublin, National University of Ireland, Dublin, Ireland (18 Months) (Recruiting institution) • INRAE, Clermont-Ferrand, France (18 Months)
Doctoral schools	• UCD SGS @ University College Dublin, National University of Ireland, Dublin, Ireland • SVSAE @ University Clermont Auvergne, Clermont-Ferrand, France
Supervisors	• Pr. Tahar Kechadi (University College Dublin, Ireland) • Dr. Guillaume Charrier (INRAE, France)
Non-academic mentors	• Mr. M. Connolly (M2Geo, Ireland) • Dr. A. Proust (Mistras, France)
Secondments (1 to 6 hosting months)	• M2Geo, M. Connolly, 26th month, 3 months, identification of most appropriate methods and technological solutions used in industrial for multimodal data analytics and the use of cloud computing tools. • Mistras, 9th month, 3 month, training and advances about acoustic emissions and preprocessing data.
Contact information	• tahar.kechadi@ucd.ie • guillaume.charrier@inrae.fr

RECRUITMENT CRITERIA

General criteria

- MSCA Mobility Rule: researchers must not have resided or carried out their main activity (work, studies, etc.) in Ireland 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

- Advanced Machine Learning, data mining, and programming skills
- Interdisciplinary work
- Master degree in Computer Science
- A taste for plant science and field monitoring will be appreciated

APPLICATION

How to apply?

- **All information are provided here**

Deadline: **15th April 2026**

Other information

UCD

University College Dublin (UCD) is **Ireland's largest university** and one of Europe's leading **research-intensive** institutions.

- **Established:** Founded in **1854** by John Henry Newman as the Catholic University of Ireland, it is one of Ireland's oldest universities.
- **Location:** Its main campus, **Belfield**, is a large, modern, and beautiful parkland estate spanning 133 hectares, located about six kilometres south of Dublin's city centre.
- **Size:** UCD hosts over **38,000 students**, making it the largest university in Ireland. It has a significant international presence, with students from over 150 countries.
- **Academics & Reputation:** It's consistently ranked within the **top 1% of higher education institutions** worldwide. UCD is highly regarded for its commitment to research and its graduates' **employability**, ranking #1 in Ireland for this metric.
- **Affiliation:** It is a constituent college of the **National University of Ireland (NUI)**.

UCD School of Computer Science

The UCD School of Computer Science is the **largest computer science department in Ireland** and is known for its strong emphasis on both the principles and practice of the field.

- **Location:** The school is primarily located within the state-of-the-art **UCD Science Centre (also known as the O'Brien Centre for Science)**, on the Belfield campus.
- **Programs:** It offers a comprehensive range of programs, including a 4-year **BSc Honours degree in Computer Science** (with specialisation options like Data Science & AI), various Masters degrees (MSc) for both Computer Science graduates and conversion students, and a Structured PhD program.
- **Research Excellence:** The school is a hub for high-impact research, contributing to Ireland's national research efforts. Key research areas include:
  - **Data Science, Machine Learning & AI**
  - **Computer Security** (including Digital Forensics)
  - **Digital Health**
  - **Human-Computer Interaction (HCI)**
  - **Software Engineering and Distributed Systems**
- **Research Centres:** It is a co-host for major Science Foundation Ireland (SFI) Research Centres, notably the **Insight Centre for Data Analytics** (Ireland's largest data research centre) and the **CeADAR** (Centre for Applied Data Analytics & AI), which links applied research with commercial deployment

INRAE and PIAF research unit

INRAE. The French National Research Institute for Agriculture, Food and Environment (INRAE) is a public research institution bringing together a working community of 12,000 people, with 272 research, service, and experimental units located in 18 centers throughout France.

INRAE ranks among the world's leading institutions in agricultural and food sciences, and in plant and animal sciences. Its research aims to build solutions for multi-performing agriculture, quality food, and the sustainable management of resources and ecosystems.

UMR PIAF: Integrative Physics and Physiology of Trees in Fluctuating Environments

PIAF stands for **P**hysique et **P**hysiologie **I**ntégratives de l'**A**rbre en environnement **F**luctuant (Integrative Physics and Physiology of Trees in Fluctuating Environments).

- **Affiliation:** It is a joint research unit (**UMR**) of **INRAE** (The French National Research Institute for Agriculture, Food and Environment) and the University of Clermont Auvergne (**UCA**).
- **Core Focus:** The unit studies how living trees (in forests, cities, or agricultural areas) function, react, and adapt to major environmental factors, especially those impacted by climate change, such as **drought, heat, cold, and wind (mechanical stress)**.
- **Mission:** Their goal is to understand the mechanisms of tree resistance and resilience at various scales (from cells to forest stands) to:
    - Identify resilient tree **genotypes** or **ecotypes**.
    - Propose sustainable **management methods** for tree systems and agroforestry.

Your Quality of Life at INRAE

By joining INRAE, you benefit from (depending on the type and duration of your contract):

- Up to **30 days of paid leave** + **15 RTT** days per year (for a full-time position);
- **Parental support**: **CESU** for childcare, benefits for leisure activities;
- **Skill development schemes**: training, professional orientation counselling;
- **Social support**: advice and listening, social aid and loans;
- **Holiday and leisure benefits**: *chèque-vacances* (holiday vouchers), accommodation at preferential rates;
- **Sports and cultural activities**;
- **Collective catering** (cafeteria/canteen).

The Cézeaux site is served by Tram Line A, and is also equipped with parking and services dedicated to cycling.

Notes on terms:

- **INRAE**: The French National Research Institute for Agriculture, Food and Environment.
- **RTT** (*Réduction du Temps de Travail*): Days off granted in compensation for working slightly more than the official legal working hours (a mechanism for reducing working time in France).
- **CESU** (*Chèque Emploi Service Universel*): A payment voucher/scheme in France used to pay for personal services, often including childcare. **CESU for childcare** refers to a specific pre-financed voucher for childcare expenses (usually for children aged 0-6).

- ***Chèque-vacances***: Government-subsidized holiday vouchers in France used to pay for travel, accommodation, and leisure activities during holidays.