Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin

Digitising biodiversity: Landscape-Animal-Digital-Human Translations

An exciting new multi-disciplinary project is looking to recruit four new PhD students to work together to develop a ground-breaking new smart environmental monitoring system. Our aim is to bring about a step-change in the monitoring of biodiversity, transforming the resolution, quality and interpretation of data, while addressing explicitly what is lost and gained through digital translation from animal to human understanding. Together, the multi-disciplinary project team will develop and integrate acoustic, visual and mm-wave all-weather radar sensors, process, analyse and interpret the data they produce using AI species-recognition and a range of statistical tools, and address the translation of information from landscapes and animals via digital means to human understanding.

PhD1: **Development of 360 audiovisual technology for monitoring biodiversity**
Primary supervisor Professor Anil Kokaram (Engineering), co-supervisor Professor Yvonne Buckley (Natural Sciences).
Non-invasive monitoring of the environment is an important part of efforts in conservation and management. We will deploy 360 video cameras as sensors for detection and tracking of birds, small animals and insects. We will develop efficient object detection algorithms by deploying Deep Neural Networks together with classical video processing techniques.

PhD2: **Development of mm-wave radar technology for monitoring biodiversity**
Primary supervisors Professor Nicola Marchetti (Engineering) and Dr Adam Narbudowicz (SFI CONNECT Centre), co-supervisor Professor Jane Stout (Natural Sciences).
We are seeking a PhD candidate to develop future radar and electromagnetic sensors for biodiversity monitoring. The sensors will provide currently unavailable data on insects (e.g. bees) and biodiversity, supporting information that is difficult to obtain though state-of-the-art visual sensing. The work will involve advanced mm-Wave radars, new AI algorithms for radar signature classification and creation of detailed numerical electromagnetic models of different species. Some experience with at least one of the following will be advantageous: Machine learning for autonomous classification problems; full-wave electromagnetic simulators (e.g. CST, HFSS); insect handling; electromagnetic modelling or measurement of biological tissues.

PhD3: **Capturing signals in biodiversity data across scales in space and time**
Primary supervisor Professor Caroline Brophy (Statistics), co-supervisor Professor Ian Donohue (Natural Sciences).
Real-time data can be challenging to analyse and interpret as it can be highly variable (noisy), multivariate, zero-inflated and complex in structures over space and time. In this PhD project, the successful candidate will develop statistical models to analyse the big data that arises from real-time biodiversity monitoring. Applying these models will facilitate the detection of any underlying and biologically meaningful biodiversity patterns and signals in the data across multiple scales. In a truly multidisciplinary and circular approach, the knowledge gained from these statistical analyses will help to iteratively refine and improve our biodiversity monitoring processes.

PhD4: **Translating non-human interactions via digital means to human understanding**
Primary supervisor Professor Michael Cronin (Languages, Literatures and Cultural Studies), co-supervisors Professor Yvonne Buckley and Professor Ian Donohue (Natural Sciences).

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How can humans translate information they receive from the natural world into information that is intelligible to them, yet avoids the pitfalls of anthropomorphism? This project will explore the different forms of human/non-human communication used in specific locations and the nature of the translation paradigms underlying these practices. The purpose will be to establish how translation can help us to think about resilient and mutually-respectful forms of human/non-human engagement in different contexts and how this can help develop more sustainable versions of human identity and self-understanding in the Anthropocene.

All four PhD students will work as a team and so excellent team working and communication skills are required. Ideally, experience or interest in biodiversity and addressing environmental challenges is desirable. This project is part of a highly interdisciplinary team, and so excellent team working and communication skills are required. Each candidate will produce an independent piece of research in the form of a PhD thesis based on their individual research projects.

Project	Primary supervisor	Contact	Requirements
1. Development of 360 audiovisual technology for monitoring biodiversity	Prof Anil Kokaram	Anil.Kokaram@tcd.ie	Primary degree in Engineering or Science with experience in video and signal processing. A capstone project in these areas would be an advantage.
2. Development of mm-wave radar technology for monitoring biodiversity	Dr Adam Narbudowicz	narbudoa@tcd.ie	M.Sc./B.Sc. with thesis related to one of the following specializations: antennas, radio/electromagnetic propagation, radar systems or a related topic
3. Capturing signals in biodiversity data across scales in space and time	Prof Caroline Brophy	Caroline.Brophy@tcd.ie	Undergraduate (upper second class or higher) or master's degree in Statistics, Mathematics or similar quantitative field.
4. Translating non-human interactions via digital means to human understanding	Prof Michael Cronin	croninm8@tcd.ie	Ideally, applicants would have a master's qualification and a background in translation studies, anthropology or animal studies.

This project is part of the Kinsella Challenge-Based E3 projects at Trinity College Dublin, and PhD students will have the opportunity to work alongside those from the other successful projects, particularly in terms of team-building and dissemination events.

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The PhDs are all 4-year structured programmes, with an anticipated start date of September 2021.

Application Process

Applications can be made through by clicking here....
Late applications will not be accepted. Informal enquiries should be made to the primary supervisor. Completed applications should be submitted to via the above link and will require :

1. A curriculum vitae (including the names of two referees, one of which must be an academic referee).
2. A cover letter (maximum 1000 words) outlining the applicant's research interests and why they are suitable for this project.

Applications will be jointly reviewed by project supervisors. Shortlisted applicants will be invited to video-interview. Successful applicants will subsequently apply to register as PhD students through the Trinity College Dublin central portal but must meet all requirements for registration in order to be eligible for this funding award. Postgraduate admission requirements are available here: https://www.tcd.ie/study/apply/admission-requirements/postgraduate/. The successful applicant will be required to provide evidence of English language competence following the award offer and before registering.

About the Project

Obtaining reliable biodiversity data on the ground is expensive, requiring field surveys, sample collection and processing and consequently tends to be done at coarse spatial and temporal resolutions. This hinders our understanding and capacity to predict the impacts of human disturbances of ecosystems, causes tension between industry and environmental conservation by increasing the cost of environmental impact assessments, and undermines the effectiveness of both national and international environmental legislation and policy, including the UN Sustainable Development Goals.

Digitising Biodiversity will develop and integrate three technologies—acoustic, video and radar—to monitor biodiversity, and will use AI machine-learning and state-of-the-art statistical tools to integrate and interpret the resulting information, while also addressing explicitly what is lost and gained through this process of digital translation of information from landscapes and animals to human understanding. We have assembled an accomplished, balanced and highly-multidisciplinary supervisory team to meet the diverse combination of technological, computational, statistical, ecological and translational challenges the project poses, to bring about a step-change in the measurement, recording and translation of biological data from nature.

The technologies:

Microphone arrays allow localisation and enhancement of sound, augmenting detection and classification accuracy of mid-range 360 video sensors. We will combine these media modalities with low-power mm-wave radar technology, which will be able to detect small animals like insects and provide additional rich information, including body size, flight speed and trajectory. This has never been done before.

Data processing and analyses:

Data collection is being undertaken at unprecedented scales across the globe, including in the monitoring of biodiversity. However, biodiversity data collection is costly and delivers data at coarse spatial and temporal resolutions. Our project will dramatically improve both the quality and quantity of biodiversity data by capturing data from multiple targeted scales from small insects to larger animals and birds simultaneously, generating complex multivariate data to which we will apply statistical modelling techniques to translate our 'big data' collection efforts into 'big information' knowledge gain. The data produced will have many dimensions: multivariate responses, varying scales of measurement, and real-time spatial and temporal gradients. We will develop statistical models that identify the patterns and signals that are most meaningful across particular focal scales in space and time in the highly variable and 'noisy' data. In a truly multidisciplinary and circular approach, we will use the knowledge gained from these analyses to iteratively refine and improve our biodiversity monitoring processes.

Translation:

There is a growing body of literature in the humanities and social sciences that is investigating the relationship between the human and the more-than-human. The emphasis is on developing a relational ontology that considers human identity in relation to the non-human world. Rarely addressed, however, is what is to be the communicative basis of this relationality? How are humans to engage with and understand the non-human? How do they translate information they receive into information that is intelligible to human communities, yet avoids the pitfalls of anthropomorphism? Our project will establish how translation can help us to think about resilient and mutually-respectful forms of human/non-human engagement in different contexts and how this can help develop more sustainable versions of human identity and self-understanding in the Anthropocene. By giving concrete expression to the development of ethical forms of human/non-human communication, it will provide a model for best practice elsewhere.

The diverse and exciting combination of technological, computational, statistical, ecological and translational challenges at the core of this project means that it aligns fully and elegantly with all of the key perspectives of E3, to bring about "*Technology developed in symbiosis with the natural world to meet the challenges of our time and create a more sustainable future*".