Research Experience Placement (REP) Scheme 2025

Supervisor Project Proforma

Project title:	Using 3D models from smartphone video to assess urban tree crown volume.
Host Institution:	The Open University
Project supervisor (name, department):	Philip Wheeler, School of Environment, Earth & Ecosystem Sciences
Project enquiries (supervisor email):	Philip.wheeler@open.ac.uk
Co-Supervisor, if any (name, department):	Franck Hétroy-Wheeler, Knowledge Media Institute and University of Strasbourg
Proposed start date and weekly hours: (please note project must be of 6 weeks duration)	30th June 2025 for 6 weeks

Please provide a short paragraph or couple of sentences summarising the project to encourage potential applicants to apply (max 75 words)**:**

This project will investigate whether smartphones can be used to collect critical data about urban trees. Working at the crossroads of ecology and computing, you will work with computer scientists and urban tree specialists on the development and testing of a smartphone app for generating 3D models of trees and extracting key parameters from them. It will involve a literature review, code evaluation and development, and quantitative field assessment.

Project description (max 700 words, 1-2 figures may be included):

Proposed projects must:

- Have a clearly defined objective.
- Be within the science remit of NERC.
- Be feasible for a student to complete within the timescale of the placement.
- Include more than purely a computer/modelling component i.e., some element of fieldwork, data collection, activity to give an understanding of the wider context including participation in lab/team meetings, networking, and training etc.
- Give scope for thought and initiative on the part of the student and should not use the student as a general assistant.
- Be based at an eligible UK research organisation (remote placements are also an option for enabling inclusivity).

Trees are vital elements of towns and cities. They provide a wide range of environmental and societal benefits such as reducing temperature, pollution and flood risk, shaping the character of urban areas and connecting us to our history and culture. But looking after urban trees is challenging: monitoring their growth and condition is usually a task for experts. This project will address the question of whether key tree parameters can be extracted from 3D models built only from a smartphone video. More specifically it will aim to refine and evaluate an existing processing pipeline to generate data on urban tree crowns.

The crown of a tree refers to its upper part above the trunk, including its branches, leaves, and reproductive organs. Biologically, it is the portion of the tree mainly responsible for photosynthesis, respiration, and reproduction. The crown plays a vital role in energy production,

growth, and health of the tree. Calculating a tree's crown volume is an important task in forestry, ecology, and forest management for several reasons, such as understanding a tree's growth potential, estimating biomass, assessing tree health, and determining its role in carbon sequestration.

However, measuring the crown volume is challenging. In field studies it is usually estimated using either geometric models that approximate the crown as a regular shape, or allometric equations from more easily measured variables like tree height and trunk diameter. It is possible to measure crown volume precisely with high resolution LiDAR scanning methods, but these are costly, time consuming and require specialist equipment and knowledge. A quick, low cost and easily useable method for measuring tree crowns would greatly increase our ability to monitor trees.

We have developed a citizen science approach, based around our smartphone app UrTrees, to directly estimate the crown volume from a single video of the tree[1] (see images below), making it much easier and faster. However, this approach needs refining and testing in order to provide detailed data on tree canopies. The objective of this project is therefore to review the existing code, refine it and then evaluate the whole pipeline in comparison to field measurements of tree canopies.

The project will begin with a literature review of tree crown definitions and volume estimation methods in environmental and forest sciences. Then the student will install the UrTrees app, get familiar with its use as well as with the C++ and Python code of its data processing pipeline. In particular, the student will need to understand how the tree crown volume is computed in the pipeline. Once familiar with the processing pipeline, the student will have to modify the C++ code to optimise the crown volume computation. Following this code development, a number of trees with various crown shapes and sizes will be selected for field survey. These will be scanned with the UrTrees app and field measurement of various crown parameters (width, height, depth, etc.) will be taken with standard field survey tools. The data from these field surveys will then be used in a statistical comparison of crown volume estimation with the UrTrees pipeline and with selected methods based on field measurements. Finally, a technical report and presentation summarising the work done and concluding on the efficiency of the UrTrees app for tree crown volume computation will be produced.

The student will have weekly meetings with project supervisors to report on progress and discuss challenges and next steps.

Project timeline:

The project is designed to run for six weeks, with a different task assigned each week. The

1 https://urtrees.icube.unistra.fr/

schedule below is indicative and may change depending on project progress.

Week 1: Literature review on crown assessment methods
Week 2: Familiarisation with app and code
Week 3: Code development
Week 4: Field surveys
Week 5: Data processing and analysis
Week 6: Write up and presentation

Candidate requirements:

The student should be familiar with C++ and Python programming.
There is some field work planned so the student should be able to access field sites of urban trees.
The student will ideally be based for the duration of the project in Milton Keynes, though other locations may be considered.

Background reading and references:

The UrTrees homepage https://urtrees.icube.unistra.fr/ introduces the app and wider project.

Pace et al. (2022) Tree Measurements in the Urban Environment: Insights from Traditional and Digital Field Instruments to Smartphone Applications. *Arboriculture & Urban Forestry*, 48 (2) 113-123; DOI: 10.48044/jauf.2022.009

Z. Zhu et al. (2021). Assessing tree crown volume—a review. *Forestry: An International Journal of Forest Research* 94, 18–35 https://doi.org/10.1093/forestry/cpaa037.