

FoodBioSystems DTP - PhD Project Advertisement Text

Project Title: FOODBIOSYSTEMS - Deep learning based phenotyping of crop seed banks and herbaria

Lead Supervisor: John Doonan, Aberystwyth University, IBERS

Email: John.doonan@aber.ac.uk

Co-Supervisors:

Lilian Tang, University of Surrey, Computer Science: h.tang@surrey.ac.uk

Chuan Lu, Dept of Computer Science, Aberystwyth University: cul@aber.ac.uk

Danny Thorogood, AberInnovation Seed Biobank, IBERS, Aberystwyth University: dnt@aber.ac.uk

Research Group: FOODBIOSYSTEMS BBSRC DTP

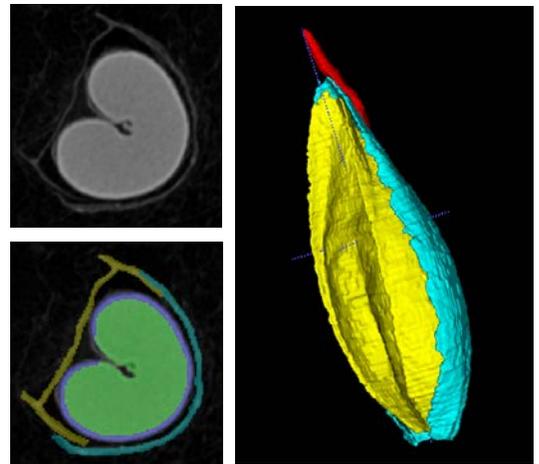
Project ID: FBS2020-36

Application Deadline: 6 March 2020

Project Description: Biodiversity underpins long term sustainability of both ecosystems and agriculture. The study of biodiversity, as represented by Herbaria, is one of the oldest branches of biology stretching back at least 400 years. The physical materials stored within Seed Banks and Herbaria provide a largely unexploited source of information on biodiversity in the recent past. This project aims to develop automated non-destructive tools, based on state of the art imaging combined with computer vision and deep learning to mine these collections of physical specimens for information that could be used for crop improvement and understanding agri-ecology over the past century

The project is based on the exciting discovery of a huge repository of documented seeds and physical vouchers, assembled over the last 100 years of the breeding programs at Aberystwyth University. These archives are now part of the **IBERS Seed BioBank** located on the new **Aberystwyth Innovation & Enterprise Campus**. They represent a unique opportunity to explore anthropogenic effects on species and agri-ecosystems in the context of an active crop improvement program. Current commercial crops have an extremely narrow genetic base selected to perform well in high input farming. This is a general vulnerability in the face of increasing pest diversity and the need to reduce input to combat climate change. Crop related seed banks include many heritage varieties with potential value for breeding novel resilient strains that can cope better with extreme weather, lower inputs and other pressures arising from future climate scenarios. The challenge is to extract this information in a systematic manner that useful to researchers, breeders and agriculture.

Fig.1 An example of Machine learning on wheat grains. Top Left – original image from a bench top micro CT scanner; Bottom Left – the image showing annotation by human expert; Right – accurately annotated 3D uCT model suitable for quantitative measurement of many features.



Funding Notes: This project is part of the FoodBioSystems BBSRC

Doctoral Training Partnership (DTP), it will be funded subject to a competition to identify the strongest applicants. Due to restrictions on the funding, this studentship is only open to UK students and EU students who have lived in the UK for the past three years.

The FoodBioSystems DTP is a collaboration between the University of Reading, Cranfield University, Queen's University Belfast, Aberystwyth University, Surrey University and Brunel University London. Our vision is to develop the next generation of highly skilled UK Agri-Food bioscientists with expertise spanning the entire food value chain. We have over 60 Associate and Affiliate partners. To find out more about us and the training programme we offer all our postgraduate researchers please visit <https://research.reading.ac.uk/foodbiosystems/>.

Training opportunities: In this interdisciplinary project, the student will work with geneticists at Aberystwyth, archivists at Aberystwyth and Kew Gardens and computer scientists in both Aberystwyth and Surrey. You will learn a range of specialist bio-medical imaging skills, including the use of high resolution cameras and microscopes, X-Ray microCT and XRF, and combine this with computer vision skills to apply deep-learning algorithms to explore and exploit the data. Also, Aberystwyth University retains a strong public-good plant breeding program, so you will have the opportunity to work closely with breeders and be trained in crop genetics, including specialist software for QTL analysis and GWAS. Plant Breeding has been identified as a major skill-gap in the UK and has excellent career opportunities, particularly when combined with new ways of collecting and handling large datasets. Collaborative supervision from the University of Surrey provides training opportunities in advanced computer science and there will be the opportunity to visit other centers working on biodiversity, such as Kew Gardens. There may also be opportunities to spend time at other major plant phenotyping centres in Europe, Australia or China.

Student profile: We are looking for highly motivated candidates who should have (or expect to achieve) a minimum of a 2.1 Honours degree in a relevant subject area related to the biological sciences, computer science or agriculture. Applicants with a minimum of a 2.2 Honours degree may be considered providing they have a Distinction at Masters or significant relevant outputs/experience, such as publications. Candidates, where English is not their first language, may need to provide evidence of qualifications.

References:

Clark, Corney and Tang (2012) "Automated Plant Identification Using Artificial Neural Networks", CIBCB2012, IEEE Symposium on Computational Intelligence in Bioinformatics and Computational Biology. doi: 10.1109/CIBCB.2012.6217250

Hughes et al. (2019) μ CT trait analysis reveals morphometric differences between domesticated temperate small grain cereals and their wild relatives. *Plant J.* 99:98-111. doi: 10.1111/tbj.14312.

Hamidinekoo, et al., (2020) DeepPod: A Convolutional Neural Network Based Quantification of Fruit Number in *Arabidopsis*. *GigaScience* in press (doi will be supplied shortly)

Google Scholar link for Doonan Lab. <https://scholar.google.com/citations?user=6KcPHw8AAAAJ&hl=en>

Link to National Plant Phenomics Centre <https://www.plant-phenomics.ac.uk/>