# DEEP LEARNING FOR PIXEL-WISE CLASSIFICATION OF SWIR SPECTRAL IMAGES

*Jun-Li Xu, Ana Herrero-Langreo, Aoife A. Gowen*

School of Biosystems and Food Engineering, University College of Dublin (UCD), Ireland

Deep learning attracts growing interest in a variety of applications. This work aims to apply deep learning approaches for pixel-wise classification of spectral imaging datasets, which was compared to partial least square discriminant analysis (PLSDA) in terms of accuracy, exemplified through two case studies, namely, classification of three varieties of puffed cereals and discrimination of two bacterial strains (*Bacillus subtilis* and *Escherichia coli*). A three-dimensional convolutional neural network (3-D CNN) was applied to simultaneously extract spatial and spectral features of cereal images in the range of 943 – 1643 nm. Results showed that the accuracy of an independent image increased from 92.33% using PLSDA to 99.4% using 3-CNN model at pixel level. SWIR spectral images (997 – 2517 nm) of bacterial suspensions deposited on stainless-steel and mirror aluminium substrates were acquired. Long short-term memory (LSTM)) models were developed for discrimination of bacterial species, leading to the accuracy of 80% and 83% for stainless-steel and aluminium substrates, respectively. In contrast, PLSDA resulted in the accuracy of 78% and 67% respectively for stainless-steel and aluminium slides. This work evidences the superior performance using deep learning algorithms in both cases.

***Index Terms—*** Spectral imaging, deep learning, classification, pathogen detection, SWIR