

EPSRC CDT in Distributed Algorithms

PhD Project: Implementing Advanced Image Analytics in a Compressed Sensing and Machine Learning Framework

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Project Description

This project has been developed by the University of Liverpool in partnership with Sivananthan Laboratories.

Extracting quantitative information from nanoscale images of materials structures and processes is a repetitive and costly process. Currently humans are required to manually acquire images from experimentation and compare them with large repositories of data to find physical/chemical properties of nanoscale materials systems. In many cases, these databases often contain images with large disparities in their noise patterns, spatial/temporal resolution, magnification and/or signal-to-noise ratio, making the identification and use of these features challenging to accomplish in practice.

In this project, our goal is to develop an optimised workflow for extracting quantitative information that is focused on one type of nanoscale image obtained by (scanning) transmission electron microscopy/(S)TEM. In many (S)TEM images, the size and shape (morphology) of nanoparticles and their special arrangements (dispersion) are a key analytical measure that has been demonstrated.

Recent work by Chiwoo Park and Yung Ding has made significant strides in analysis of these types of images through implementation of existing algorithms to (S)TEM images. Their recent research outlines statistical techniques for the analysis of the morphology, location, dispersion analysis and multi-object tracking analysis of nanoparticles. These techniques can be leveraged to process existing unannotated data, and will serve as a baseline for performance for comparison with future models.

This PhD will investigate generalised advanced analysis techniques to advance the capabilities (S)TEM imaging. Where applicable, supervised machine learning methods such as ANN, CNNs and Adversarial networks can be investigated for their ability to analyse images with varying degrees of noise within a microscopic setting. The aim of this project will be to leverage the support provided by the CDT to develop a generalised machine learning model capable of analysing hundreds of images. If successful, this will be used real-time during nanoscopy experiments, advancing the existing capabilities of (S)TEM research.

Go to the [EPSRC CDT In Distributed Algorithms](#) website.