

EPSRC CDT in Distributed Algorithms

PhD Project: Optimized Sampling Approaches for Compressive Sensing in Multi-Dimensional Datastreams

University of Liverpool

PhD Student: Jack Taylor

Project Partner: [Sivananthan Laboratories](#)

Supervisors:

Prof Ke Chen, University of Liverpool

Dr Yalin Zheng, University of Liverpool

Prof Nigel Browning, Sivananthan Laboratories

Project Description

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

The current state-of-the-art in imaging hardware involves the very precise synthesis and fabrication of semiconducting materials into extended cameras that can now contain up to 64M pixels with a cost that can exceed £1M per device. In most cases, these high sensitivity cameras are implemented to detect signals that are very close to the noise level and as an added complexity are typically looking to characterise dynamic events. The data per image frame in these systems can easily exceed 1TB, meaning that cameras currently must operate in short bursts, have delayed responses due to the extended transfer of the data, and it can take days/months/years for image analytics to operate and identify key elements in the data stream.

One approach to alleviate these problems associated with speed and precision in state-of-the-art imaging systems, is the use of Compressive Sensing (CS) methods. In the CS approach, a small subset of random pixels in the image is acquired and used to reconstruct the full dataset. This reduces the amount of data and increases the imaging speed by the amount of sub-sampling that is used.

The goal of this PhD project is to determine the minimal level of sub-sampling that will be sufficient to reconstruct images from transmission electron microscopes. By developing and implementing new compressive sensing algorithms to tackle the challenge of hyperspectral data, the ultimate goal is to develop a coherent framework that can be used in the design of optimized imaging hardware with embedded algorithms. The project is closely related to the currently popular method of super-resolution using a single image and in the context of deep learning of artificial intelligence. The new mathematical tools of nonlinear and non-convex optimization techniques will be explored and developed.

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