# EPSRC CDT in Distributed Algorithms

# PhD Project: Scalable Track Analytics


## University of Liverpool

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## Project Description

This project has been developed by the University of Liverpool in partnership with Denbridge Marine.

This project is focused on using large historic records of sensor data from port security systems to identify the types of ship present and accurately reflect the sub-types present, i.e., perform classification and clustering in a dynamic context.

Ports deploy radars, cameras and other sensors to maintain awareness of the ships in and around the port. While ships can deliberately communicate their type (e.g., fishing boat, ferry, yacht, tug), some do not. Even those that do fail to fully characterise all the information that might be pertinent to the port (e.g., the type of fishing boat etc). A current project at the University of Liverpool is investigating how to use geometric data structures to create an abstraction of such historic data. Using this abstraction, the project is then performing behavioural classification and clustering. Unfortunately, the current processing chain requires the iterative sequential reprocessing of the data (i.e., iteratively analysing the data from start to finish) and assumes a feed-forward model (i.e., such that the pre-processing that generates the abstraction cannot be refined to improve the classification and clustering).

This project will seek to develop algorithmic approaches that can replace the current sequential and feed-forward processes with alternatives that are better suited to fully exploiting implementation on emerging many cored processing architectures. The project will involve extensive interactions with Denbridge Marine, a small company based near to Liverpool which delivers port security systems to customers around the globe. Denbridge Marine will help provide access to pertinent data, ensure that the research is well focused on challenges that their customers pose and provide a route for the techniques developed to be applied in the context of meeting those customers' needs.

This studentship has been developed by the University of Liverpool and STFC's Hartree centre in partnership with MBDA.

This PhD will develop methods to provide tactical guidance and decision making for future air defence systems. The aim will be to provide assistance to an operator that is robust, timely and that optimises the defensive response across all available assets; including platforms/vehicles, countermeasures, and interceptors.

Existing air defence systems are often optimised to provide protection against individual adversaries. Future systems are likely to require a greater level of adaptability and to provide the same degree of protection against multiple adversaries in complex, time-critical engagements. The ability to adapt to changes in tactics in real-time is a challenging computational task, and it is further complicated by constraints on the available countermeasures and other resources.

The key challenges in this work are in reducing the latency of the tactical responses (improving computational speed) and providing an indication of the reasoning behind the tactical guidance. The interpretability of the system's outputs is critical to the understanding of the system and it is likely to be a major factor in the acceptance of such techniques. It will therefore require an appreciation of high-performance computing methods, and logical reasoning with incomplete data. The industrial, non-academic partner (MBDA) will help to define appropriate scenarios and will inform the choice of constraints and system capabilities.

Go to the EPSRC CDT in Distributed Algorithms website.