EPSRC CDT in Distributed Algorithms

PhD Project: Machine Learning for Data Driven Sound Propagation Modelling

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Project Description

Sound is crucial for underwater activities spanning communication, marine biology, defence, and navigation. Effective use of current and future sensor systems requires a deep understanding of sound propagation in dynamic ocean environments. Current sound propagation models are limited and lack insight, so this project seeks to create data-driven, physically realistic models encompassing complex phenomena like internal waves, turbulence, and scattering. These high-fidelity models will improve sonar system effectiveness for all entities operating in ocean environments.

This project will develop a series of high-fidelity digital twins capable of encapsulating a number of critical dynamic phenomena, which affect the propagation of sound waves through ocean environments, including internal waves, multi-scale structural thermal and temporal variations and fluctuations, scattering by non-smooth interfaces and boundaries (e.g. semi-submerged structures, sea bed, surface), currents, eddies, and fronts.

The mechanisms associated with these phenomena are rarely studied and remain poorly understood, particularly from a mathematical and physical perspective; the majority of studies in this area are stochastic in nature and, although these models provide useful predictive capability, by their very nature, they cannot offer real physical insight into the processes involved. The present project will address these deficiencies by developing models that are simultaneously data-driven and physically realistic in order to enhance the understanding of complex and critical dynamic phenomena that have substantial impact on the propagation of sound through our oceans.

The focus of the project will be on machine learning models that can characterise successfully sound propagation in dynamic ocean environments, in the presence of multi-scale processes which are computationally or mathematically difficult to represent in physical models, in order to efficiently and intelligently estimate sound propagation for any sonar deployment.

For more information please go to the EPSRC CDT In Distributed Algorithms website.