Project proposal:
Mission Planning for Autonomous Underwater Vehicles

Background

This MSc project will be part of the research project *Ailaron*, which is running until the summer of 2021. The goal of the project is to equip an Autonomous Underwater Vehicle (AUV) with sensors and control routines to allow it to discover areas with high concentrations of plankton in the ocean, and to track those areas as they move with the ocean currents over time. To do this, an AUV will go through a series of steps:

1. Conduct an initial survey
2. Identify regions with high plankton concentrations
3. Obtain measurements of the ocean currents in the area of interest
4. Predict where those plankton will have moved to in the future
5. Identify most interesting location to visit
6. Go to that location, and search for plankton

The MSc project

The tasks in this MSc project will relate to steps 4 - 6 above. The project will employ so-called Lagrangian particle methods, which are common techniques to model transport in applied oceanography (see for example Van Sebille (2018)).

The student will first write a model to predict the movement of particles in the three-dimensional velocity field defined by the ocean currents. This involves interpolation of a gridded velocity field form an ocean model, and integration of a differential equation with a random component, *i.e.*, a stochastic differential equation. The next step will be to reconstruct a probability distribution from a collection of particles, using kernel density estimation methods, and to identify areas of interest, *i.e.*, those areas with highest concentrations of particles. These areas will then be ranked, according to their concentrations and the travel time to reach those areas, and finally, the movement of the AUV as it visits those areas will be modelled.

The student should have some experience with programming and numerical methods. No particular experience with oceanography is required.

Supervision

The project will be supervised by Tor Nordam, tor.nordam@sintef.no (SINTEF Ocean, NTNU Department of Physics), with a co-supervisor from the Department of Engineering Cybernetics.

References