Modelling Fish Trajectories through Minas Passage

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Tidal energy in the Minas Passage can only proceed if we can accurately predict the impact of tidal turbines on protected fish species, including Atlantic salmon and white shark. Previous work has provided invaluable field data from Minas Passage: satellite-tracks of surface drifters and telemetry data of tagged fish. The telemetry data has been used to calculate an encounter probability, but this estimate comes with a high level of uncertainty. In this work, we use mathematical models of the trajectories of fish through the passage to reduce this uncertainty.

We will present the results of two mathematical models. The first is a simple Lagrange particle tracking model that will be used to model drifters and passive fish. The model allows for the calculation of trajectories using different initial conditions, different phases of the tides, and different parametrizations of small-scale turbulence We will present the results of the model calibrations/validation against the known trajectories of surface drifters. We will then present the results of simulating passive fish trajectories, comparing these to the telemetry data.

Assuming that fish are relatively passive may be reasonable for smaller fish in fast moving flows of Minas Passage but is certainly not reasonable for larger fish like the white shark. However, observing fish behaviour in fast flowing currents is very difficult. The second mathematical model will be an agent-based model, where the individual fish can respond to their environment by swimming. The approach facilitates not only more realistic simulation of the likelihood of a fish encountering a tidal turbine, but also how it might respond to the turbine. We will present the results of adding simple fish behaviour, for example the preference of salmon smolts swim to the west and migrate out to the Atlantic Ocean, and determine which behaviour best agrees with telemetry data.