# Field work Porto 14.-18. September

## Objectives

* Perform operations with LAUV to adaptively monitor the water front from Rio Douro.
* Conduct 3d layer adaptively sampling and analyse data for better understanding of plume.
* Gain experience of use of LAUV for more complex operations.
* Obtain current measurements from LAUV.

## Participants

Yaolin Ge (PhD student, adaptive AUV)

Renato Mendes (Post-doc, UPorto)

Joao Sousa (Head of LSTS)

Jo?

Others?

## COVID:

* International travel might be banned, so backup needs to be reconsidered
* Depending on the vaccination progress, there is a likely possibility of going Portugal for carrying out field work
* Risk of quarantine is considered
* Number of participants are reduced
* Avoid public transport, use cars or other compact transportation as much as possible.
* MOMO (MASK ON, MASK OFF)

## Schedule

|  |  |  |
| --- | --- | --- |
| **Date** | **Tasks** | **People** |
| 1st – 2nd September | Travel to Portugal by possibly means (car or plane or boats, quarantine or not) | YL & |
| 14th September | Quarantine end | YL & |
| 15th September | Lab visit to get familiar with equipment  Renato introduces interface and so on, pack up test equipment for transport testing | YL & RM |
| 16th September | Out for test | YL & RM |
| 17th September | Out for test | YL |
| 18th September | Out for test | YL |
| 19h September | Out for test | YL |
| 20th September | Out for test | YL |
| 21th ~ 25th September | Portugal tour | All |
| 1st OCT | Travel back to Trondheim |  |
| 14th OCT | QUARANTINE |  |

# AUV missions

The operation takes place in Porto River to detect the water plume with distinguishing the boundary between the ocean water and river water. The operational area has not yet been determined, but it is designed to have multiple layers in nature. More topology and bathymetry data needs to be gathered to plan in a more detailed manner.

The maximum depth of the area is 50m, and planned depth is set to 30m.

Equipment: LAUV Roald

Map

Description automatically generated

The waypoints are decided within T-REX through a GP process with a predetermined grid of waypoints. All these waypoints are within the described area. The vehicle will transit from grid node to grid node based on updating the GP model with salinity and temperature data, and two different sampling strategies will be tested.

Algorithm 1 has the objective to reduce the variance in the GP model and create a map of the plume distribution. This means the vehicle will go at points where it believes it either does not have sufficient information or revisit nodes that have been visited too long ago.

Algorithm 2 uses a similar GP model, but with the objective of reducing the misclassification probability with respect to the ES. The waypoints should not be outside of the grid which should then ensure the vehicle would never go outside of the predefined operation area.

# Methods

## Algorithm 1 (Mapping)

In this method the spatial field is modelled by a spatio-temporal GP. The linear temporal model is built using SPDEs. The sampling strategy of the method is based on reducing the variance in the predicted field.

**Pre-run:** We want to run a “pre-run” to see how the sensor values relates to our model data. We let the AUV explore the area and use the maximum value from salinity and temperature to scale the prior of the model

**Preparation:** Before the AUV is deployed, a prior needs to be built based on SINMOD-data and Renato data.

**Input during mission:** Values from CTD sensors at the waypoint.

**Output:** Next waypoint located within the operational area.

**Desired AUV-path:** Yoyo path, with maximum depth 30 meters. The vehicle comes to the surface after every waypoint.

**Duration:** As long as possible.

## Algorithm 2 (3D Excursion set)

An area where some quantity of interest is above a given threshold or critical limit is called an *excursion set* (ES). This algorithm uses a spatio-temporal GP as in Algorithm 2, but the sampling strategy is different. We now choose the next waypoint with the goal of minimizing the misclassification probability with respect to the ES.

**Pre-run:**  As in Algorithm 1. The limit for the excursion set will also be scaled in this pre-run.

**Preparation:** Prior needs to be built based on Satellite and SINMOD-data and Renato-data.

**Input:** Values from CTD sensor at the waypoint

**Output:** Next waypoint located within the operational area.

**Desired AUV-path:** Yoyo path, with maximum depth 30 meters. The vehicle comes to the surface after every waypoint.

**Duration:** Run a mission for at least 1 hour.

## Suggested plan AUV missions

Day 1 (14th September)

* Traveling and set up
* Collect data and run pre-run

Day 2 (15th September)

* Algorithm 1 (the whole day)

Day 3 (16th September)

* Algorithm 2 (half a day)
* If time: Run Algorithm 1 again

September)

* Lawn mower for “ground truth”?

September)

* Pack up and leave