ASAROME

Autonomous Sailing Robot for Oceanographic MEasurements

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Salon Océan, Ifremer Plouzané, 5 juin 2012

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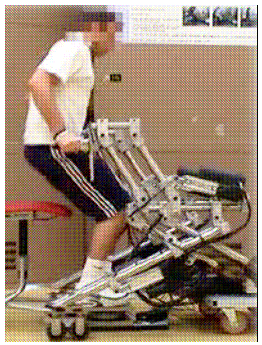
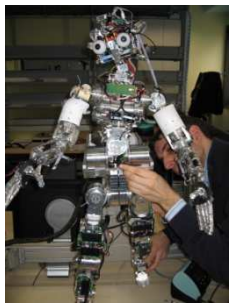
Interactive systems



Jussieu Campus

Autonomous systems



ANR ASAROME project

Partners

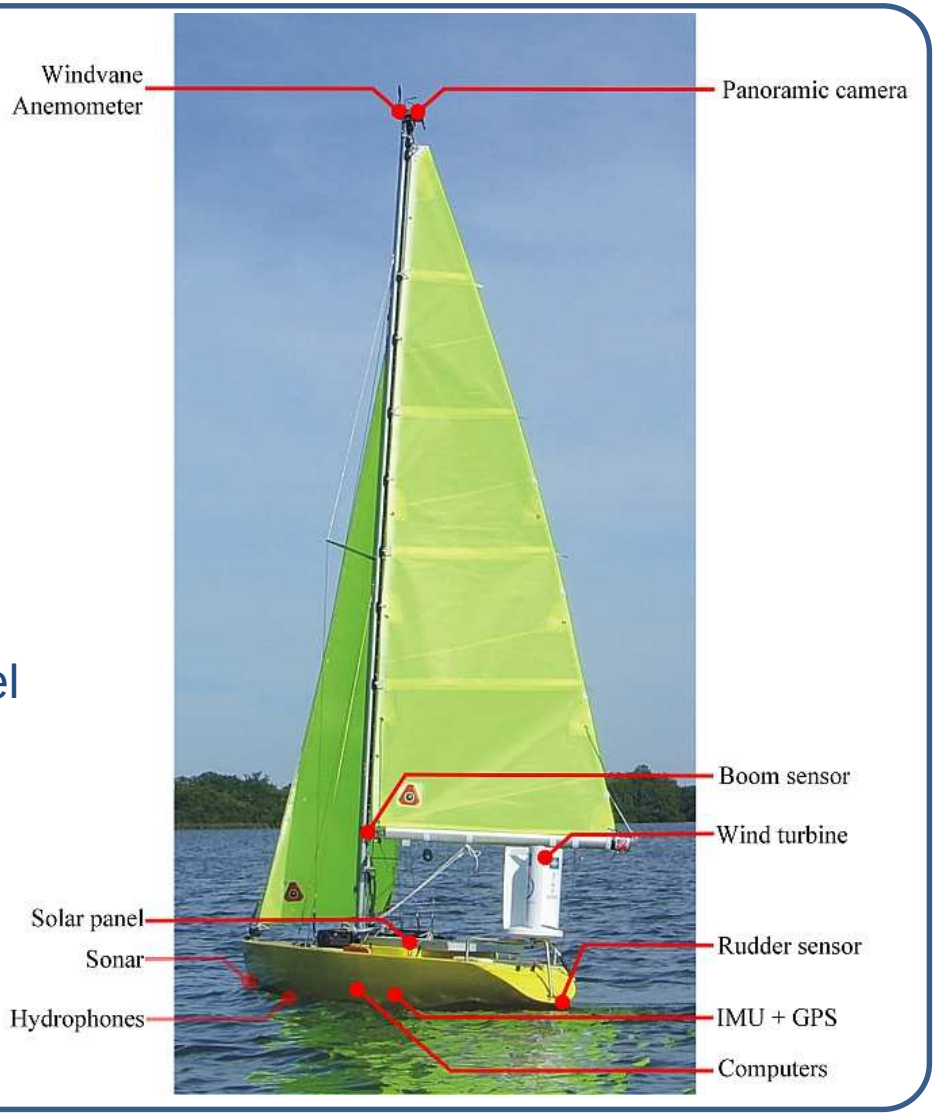
PME Robosoft: boat prototyping
LMF Ecole Centrale Nantes: logistics
ANR: fundings

Boat

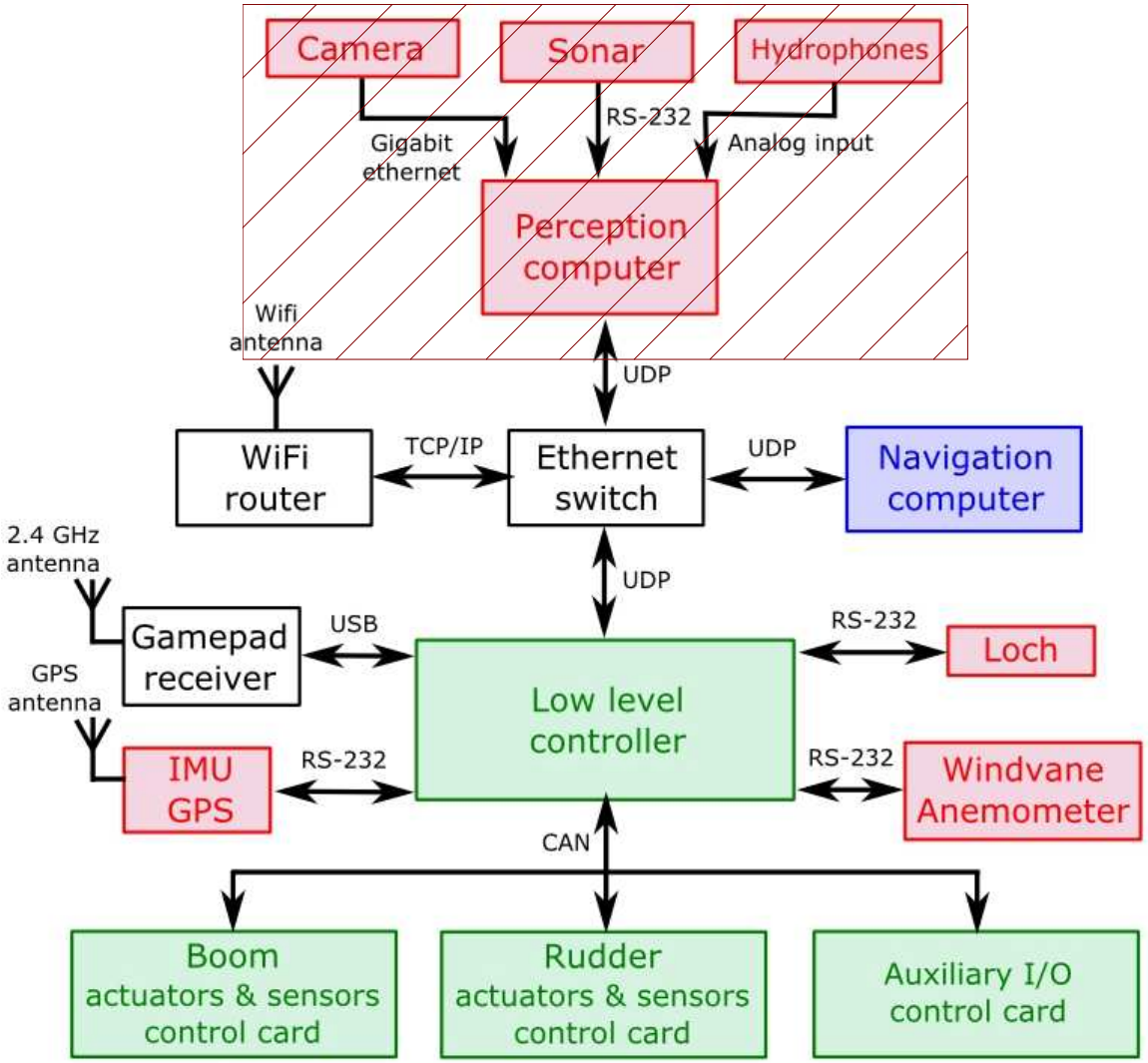
- Mini j-class sailboat
  - Weight: 223 Kg
  - Length: 3.5 m

- Powered by 12V battery + solar panel + wind turbine.

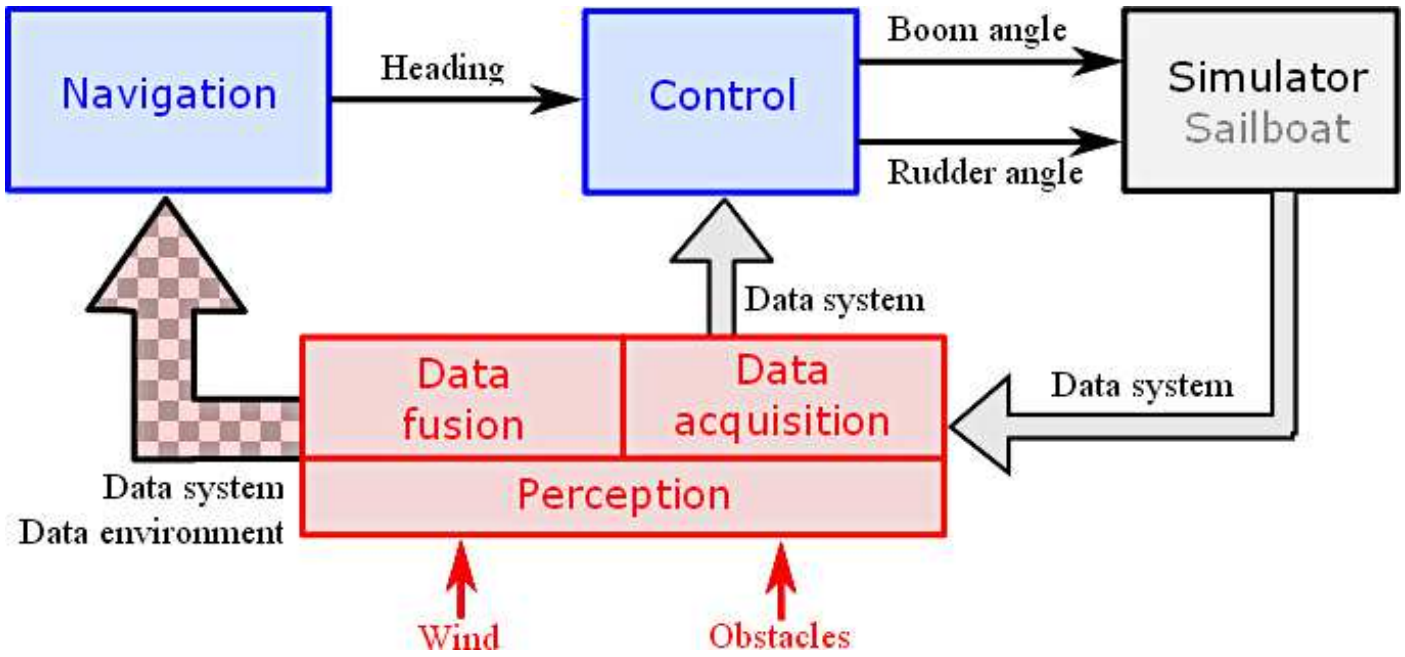
- Multiple sensor system: GPS, IMU, omni-directional camera, sonar, hydrophones, loch, wind vane, anemometer, ...



Hardware architecture



Software architecture



Reactive path planning

Objectives

- Autonomous navigation and obstacle avoidance
- Dynamic adaptation to wind variations and obstacle detection
- Real-time on-board implementation

Solution

- Potential field based path planning approach
- Local potential for kinematic constraints:
  - No-go zones
  - Speed polar diagram

Local potential

- Upwind no-go zone

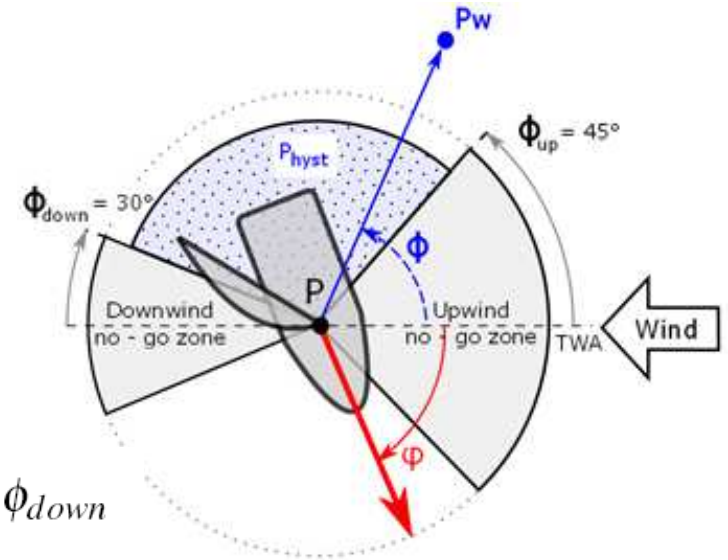
$$\begin{cases} P_{up} = G_{up}.dist(P_w, P) & \text{if } 0 < |\phi| < \phi_{up} \\ P_{up} = 0 & \text{elsewhere} \end{cases}$$

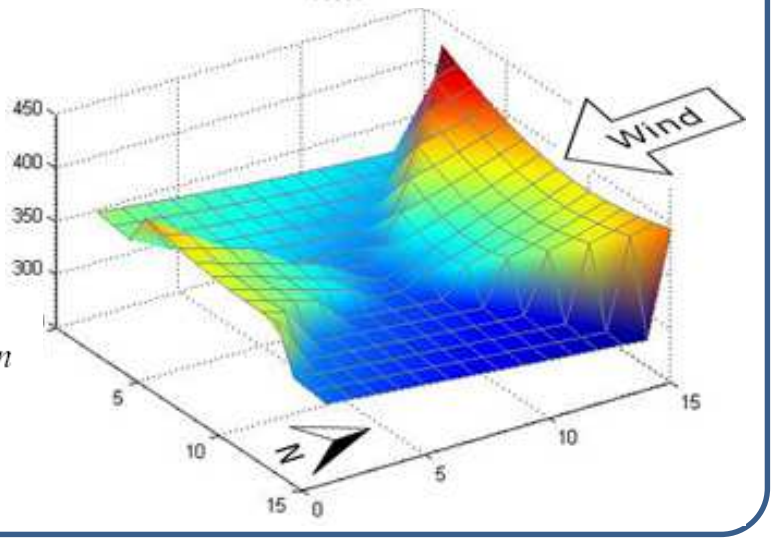
- Downwind no-go zone

$$\begin{cases} P_{down} = G_{down}.dist(P_w, P) & \text{if } 0 < |\phi - \pi| < \phi_{down} \\ P_{down} = 0 & \text{elsewhere} \end{cases}$$

- Tack and gybe manoeuvers

$$\begin{cases} P_h = G_h.dist(P_w, P) & \text{if } \phi_{up} < \phi < \pi - \phi_{down} \\ P_h = 0 & \text{elsewhere} \end{cases}$$





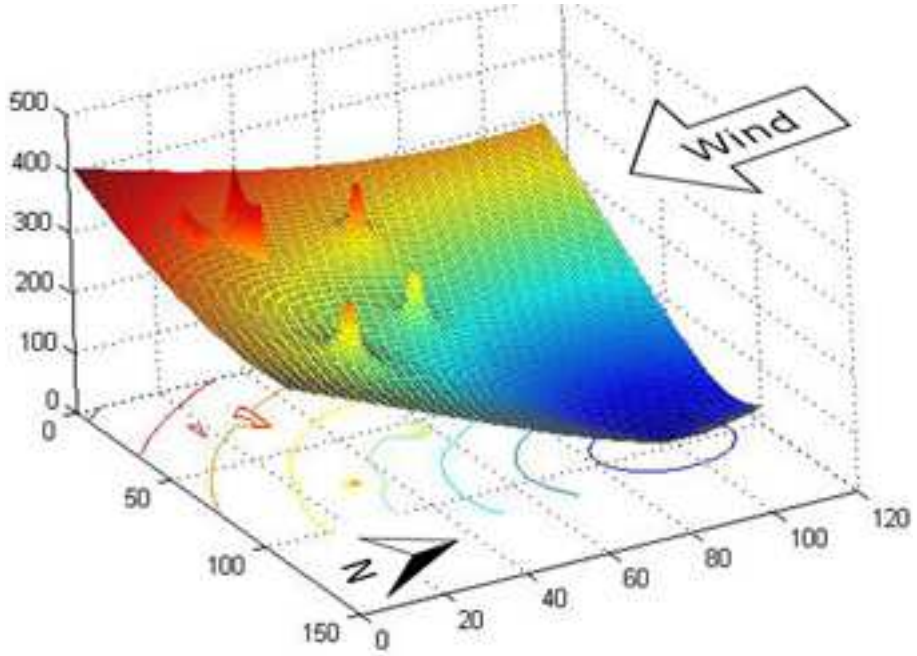
Global potential

- Attraction to the goal

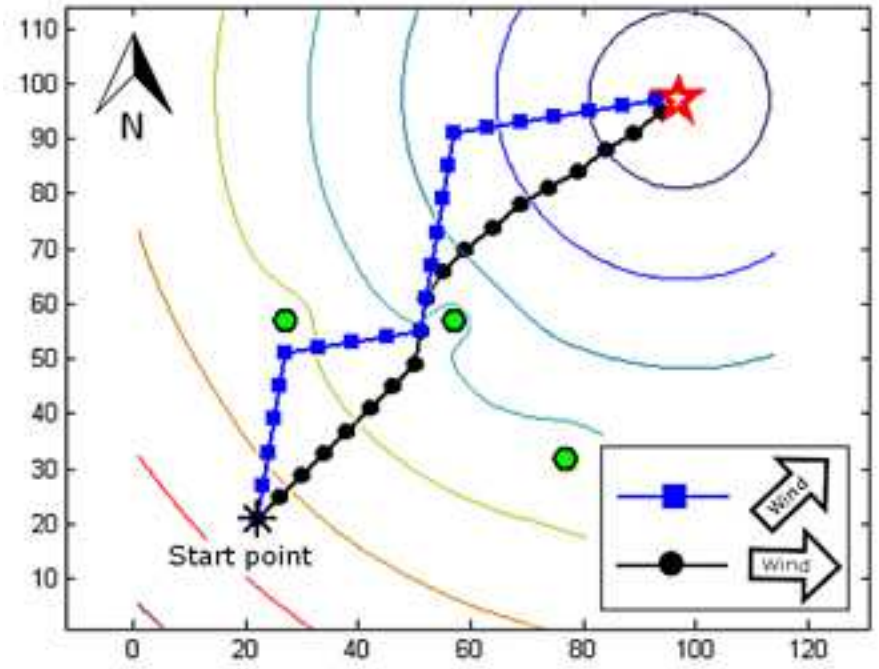
$$P_g = G_g.dist(P, P_{goal})$$

- Repulsion from the obstacles

$$P_o = \frac{k}{dist(P, P_{obst})}$$



Influence of wind direction



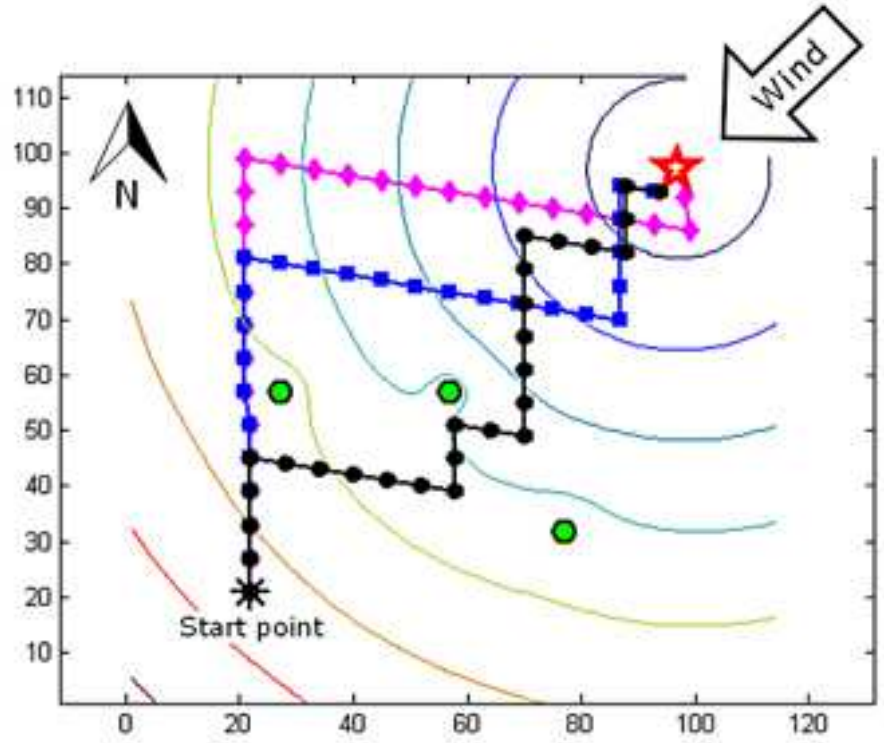
Routing + obstacle avoidance

Influence of hysteresis

Reminder:

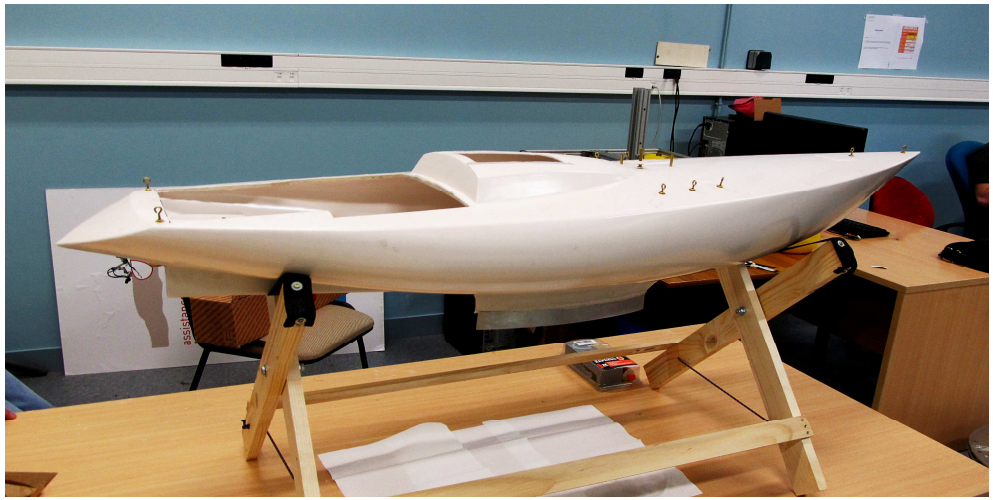
$$P_h = G_h.dist(P_w, P)$$

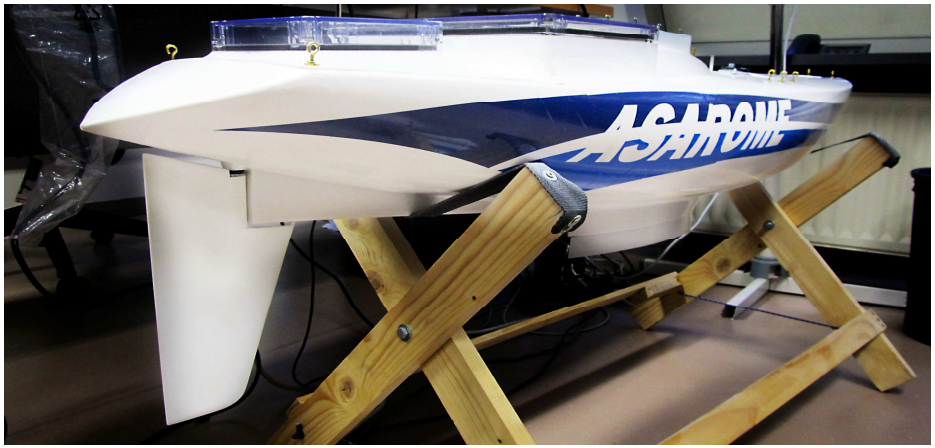
- Gh = 1
- Gh = 2
- Gh = 3



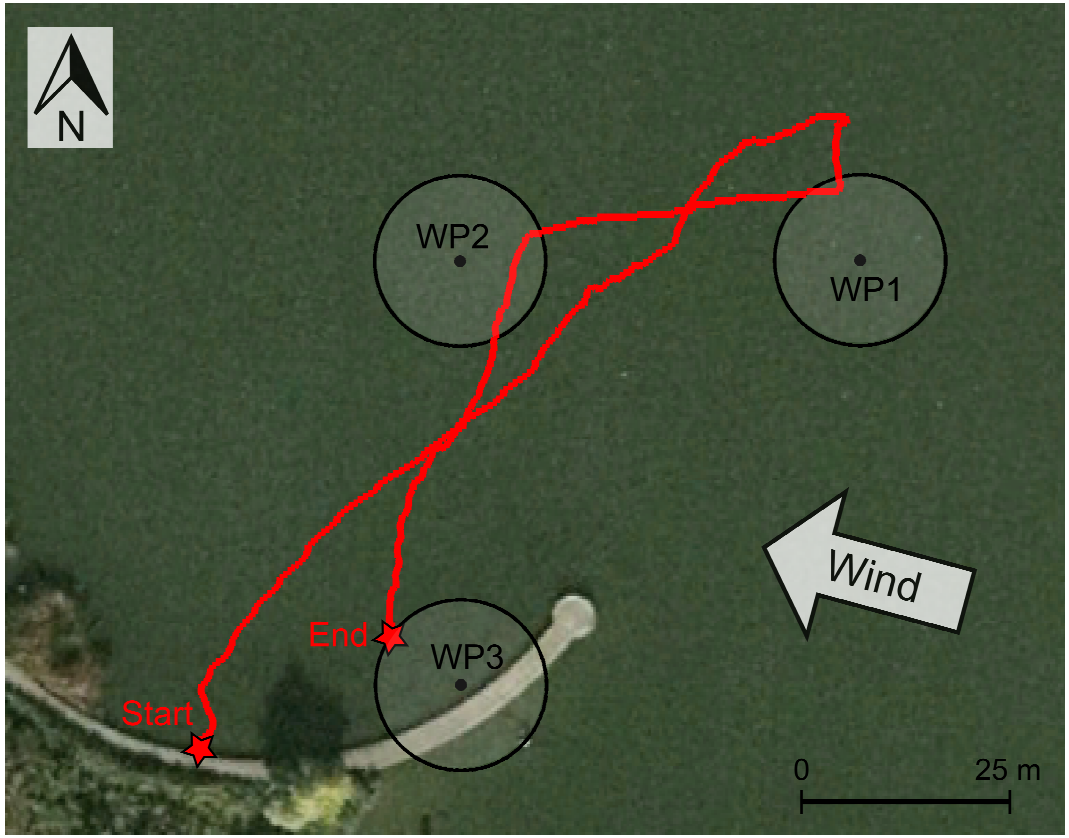
Easy tuning of cost of manoeuvers

Our baby boat...





Example of trajectory



First field trials