GOAL: Design an experimental set-up for a reduced scale mechanism of the godille’s motion.

REQUIREMENTS:
- The set-up should allow to evaluate the propulsive force of the mechanism.
- The SHARX water channel will be used to conduct the experiment.
- The dynamics of the mechanism should be controlled.

The Godille

The godille is a propulsive and directional oar taking support at the rear end of a boat. The arm movement required to use this oar is similar to an “8”. This technique is mainly used in Brittany (France) along the Channel and Atlantic coast, but also in China.

SHARX

The SHARX is a water channel with state-of-the-art measurement equipment, such as high sensitive 6 DoF load cells, PIV and dye flow visualizations. Our mechanism is compatible with the structure of the SHARX.

Inertial Analysis

We computed some relevant values to study the dynamics of our mechanism.
- Simplified model for the calculation of the global inertia (using the pieces highlighted in the figure above)
- Study on the balance of rotating masses

Experience with SHARX

We designed a set-up able to measure the thrust force along the water flow direction.
- Structure built on the SHARX rails to hold the reduced scale mechanism inside the water tank
- Strain gauges placed on the horizontal beams to measure the deformation in the direction of the flow
- Structural properties of the beams allow us to compute force values
- Possibility to add more advanced sensors and measure pitch, yaw and drag

Interaction of the fluid with the godille

Dimensionless numbers studied in various cases:

\[ f_{red} = \frac{f}{f_{L}}, \quad Re = \frac{UL}{\nu} \]

There are 5 parameters in the model that we can modify within these ranges, leading to a wide range of values for the dimensionless numbers:
- Rotation speed of the main motor: 0 to 2 Hz
- Water velocity in the SHARX: 0 to 1 m/s
- Length of the arms of rotation: 205 to 280 mm
- Inclination angle of the system: 0° to 30°
- Distance to the spherical joint: 400 to 650 mm

The adjacent graph displays all the available \((f_{red}, Re)\) combinations.

Further developments

- Add and program a motor for the angle of attack control
- Set up the experimental protocol for thrust measurement
- Run the experiments and analyze results