

# Internship in ESA's Advanced Concepts Team

on

## Bio-inspired swimmers for future robotic exploration

### Topic description

Mission to assess the thickness of the ice crust and the surface composition of Jupiter's icy moon Europa are already in the planning phase [1], opening the road for the exploration of the subsurface water oceans. Robotic exploration of these water worlds pose serious challenges, like the autonomous navigation, power delivery and data transmission under the sheet of ice.

In Earth oceans, organisms have evolved to thrive in extreme depths where resources like light and food are scarce. The evolutionary pressure resulted in energy efficient locomotion, which can provide inspiration for the design of aquatic robotic missions. To further understand, investigate and apply the principles behind aquatic locomotion, we seek to develop numerical algorithms that can simulate fish swimming patterns and behaviour. A computational fluid dynamic (CFD) code is currently under development in ACT, based on the recently introduced principles on the field [2].

### Candidate's tasks

The specific project tasks include:

- The candidate will get himself acquainted with the existing CFD python code.
- The candidate will extend the existing code to include deformable geometries.

### The ideal candidate

Mandatory:

- Strong programming skills in Python.
- Experience with fluid dynamic simulations.

Desirable:

- Experience with finite elements analysis (FEM), for example FEniCS.

### References

[1] J. I. Lunine, "Ocean worlds exploration", Acta Astronautica, Vol. 131, 2017.

[2] M. Gazzola, M. Argentina, & L. Mahadevan, "Gait and speed selection in slender inertial swimmers", PNAS, Vol. 112(13), 2015.