Internship: Iterative learning control of vessel propulsion system based on tethered kite

Supervisors: Daniel Barbuto-Rossato, Christophe Farges, Tudor-Bogdan Airimitoaie.
Keywords: feedback control, tethered kite, iterative learning control, adaptive control.
Internship description:

Figure 1: The SeaKite autonomous tethered kite for vessel propulsion from Beyond the Sea: in action for vessel propulsion (left), and image of the 100m^2 kite canopy (right).

As part of the KiWin project[1], involving three academic partners and Beyond the Sea (BTS) company (based in Arcachon, France), the IMS-laboratory (University of Bordeaux, Bordeaux INP, CNRS) is working on control and supervision algorithms design of tethered kites for vessel propulsion fig. 1. Multiple version of these kites have been developed by BTS, starting from a beach kite of 5m^2 and going up to 800m^2 for large vessel propulsion. An estimated 20% reduction in fuel consumption of the vessel is expected, providing great benefits for maritime transportation and environment preservation.

This internship will mostly focus on a 5m^2 kite version, that is not onboard the boat but on the beach. As such, it is better adapted for initial experimental evaluation of control and supervision algorithms. Robust control and supervision algorithms have been developed and evaluated [3, 5, 6].

The scope of this internship is to assess more advanced adaptive control algorithms for the kite and compare with existing robust control methods based on the CRONE methodology [7]. The focus will be in particular on Iterative Learning Control (ILC) algorithms. An initial list of bibliography items on this topic is given [1, 2, 4]. It is expected that the recruited internship student will propose and analyse in simulation an ILC algorithm for kite control before the end of the internship. The ILC algorithm is expected to optimize the control and the trajectory to maximise the traction force produced by the kite.

The main tasks of this internship are:

1. Based on existing work in the IMS-lab and available literature, understand the dynamic modelling of the kite and design a simulator (preferably in Matlab, Julia or Python can be accepted as well). Additionally, varying atmospheric conditions, tether elasticity and boat oscillations should be introduced to improve its realism.

2. Design robust feedback CRONE controller based on existing works and validate it on the simulator. Linearization based on designed simulator is necessary.

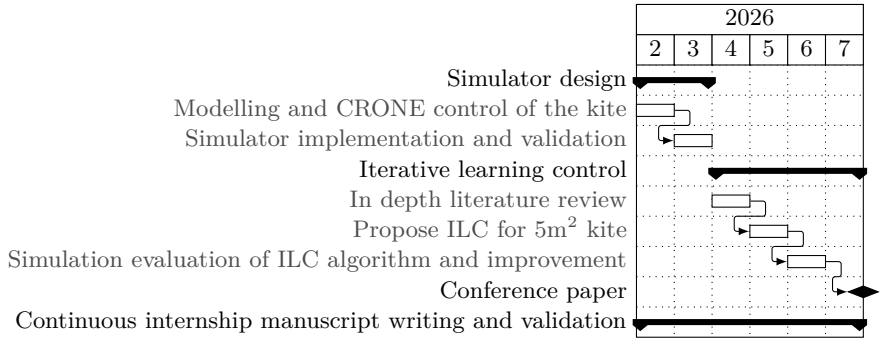
3. In depth literature review on ILC algorithms, starting with the initial references list: [1, 2, 4].

4. Propose a new ILC algorithm providing theoretical analysis based on literature.

[1] https://beyond-the-sea.com/le-projet-kiwin-revolutionner-le-transport-maritime-par-la-traction-par-kite/

5. Evaluate in simulation the proposed algorithm in various conditions.
6. Write a conference paper to present the proposed algorithm.
7. Internship manuscript should be updated continuously and adjusted as per the supervisors' comments.

A tentative scheduling of the internship task is proposed (6 months in total, from early February to end of July):



Skills: dynamic systems modelling and control, robust and adaptive control, and good coding skills in Matlab/Simulink are highly desired.
Period: February - July 2026 (6 months).
Grant: approx. 600€/month.
Location: IMS-lab, UMR 5218, 33405 Talence Cedex, France.
How to apply: send CV, motivation letter, and available grade transcripts to: daniel.barbuto-rossato@u-bordeaux.fr, christophe.farges@u-bordeaux.fr, and tudor-bogdan.airimitoaie@u-bordeaux.fr

References

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