

Master Internship proposal

Modelling and Controller design of a micro-canal device

Context

Hydrographical networks are large scale systems composed of natural rivers and artificial canals. They are used to answer Human's needs in terms of irrigation, navigation, drinking water, industry. As environmental systems, they are disturbed by several factors due to Human's activities and extreme climate events. Control strategies have been designed to reject these disturbances and guarantee the management objectives. It consists in controlling hydraulic devices (gates, weir, pumping stations), which allow to dispatch water to guarantee the needs and avoiding floods. Based on accurate model, the advanced control strategies could be implemented for an efficient management of hydrographical networks.

To deal with the design and test of controllers, a micro-canal device has been developed in the CERI SN (see picture). It is a laboratory canal of 5m with one reach and two controlled gates. It is equipped with level sensors. An interface between the Beckhoff PLC, Twincat and Matlab is available.



Objective

The main objectives consist in i) modelling the dynamics of the micro-canal by considering several operating modes, ii) identifying a dynamical model of the gates, iii) proposing controllers (PID, LQ, MPC...).

The modeling step and the design of controllers have to deal with the characteristics and complex dynamics of the canal, i.e. nonlinearity, variable delays, waves, attenuation, unsteady modes, etc. Given the inherently complex nature of canals, designing controllers by assuming linear dynamics may not be sufficient. Hence, the step aims at dealing with multi-models and multi-controllers. Based on an accurate model, control algorithms, such a Model predictive control (MPC), should be employed to guarantee the management objectives, as it offers a number of features that are suitable to deal with real hydrographical networks.

The methods will be developed in MATLAB.

Key-words

Canal, Hydrographical networks, Modelling, Control algorithms, Model Predictive Control.

Candidate profile

Student involved in Master's degree (M2 or M1)

Required skills

- Background in programming (C, Python, Matlab)
- Background in modelling, mathematical/data models
- Background in control systems, output analysis (observation) and optimization
- Environmental systems, Water systems
- Good command of English (B2 level or higher).

Location CERI Systèmes Numériques, IMT Nord Europe (Douai campus, France).

Duration 5/6 months from February 1st

Allowance 4.35€/hour which is around 600€/month net

How to apply

Send by mail: CV, cover letter, M1 and/or M2 transcripts, and recommendation letters

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References

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