Distributed control for autonomous railway pods

Postdoc position – Université de Lorraine, Nancy, France

Advisors

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Location

The research activity will take place at Université de Lorraine, CRAN, UMR CNRS 7039 : 2 avenue de la forêt de Haye, 54516 Vandœuvre-lès-Nancy, France

Duration

1 year starting preferably by October, 2025

Funding

Around 2400 €/month (net)

Keywords

Control, networked systems, interconnected systems, autonomous vehicle, stability

Context

To address environmental and climate change challenges, there is an urgent need to develop efficient and attractive transportation systems that can replace cars with eco-friendly alternatives. In this context, the company Urbanloop SAS develops an on-demand individual rail transport system that allows the user to move from one point to another without waiting, transfers, or even intermediate stops. It consists of numerous pods (see figure below) circulating autonomously on interconnected loops.

Following the successful demonstration of a 2.2 km loop enabling the circulation of 10 pods for the Paris 2024 Olympic Games, Urbanloop is now facing new challenges for a city-wide deployment. This scaling requires addressing issues related to a large number of pods, multiple interconnected loop and interaction with other users. The French national ANR COMMITS research project aims to meet these challenges.

Objectives

In this context, the objectives of this postdoctoral position in control engineering are as listed below.

- *Pods network:* The first step involves designing distributed control laws to allow for the insertion of an initially stationary pod into the loop, and analyzing its performance within the circulation network. This control must take into account all the constraints involved such as: collisions avoidance, communication and sensing limitations and the management of (dis-)insertions. Cooperative strategies based on inter-pod communications will be studied, drawing inspiration from existing works on the control of autonomous vehicles, such as e.g., [1,2,3,4,5].
- *Crossroad management:* The second step involves addressing the challenge of intersections, specifically when pods need to cross one or more roads (for motor vehicles). In a scenario where pods can control traffic lights, the objective is to determine an optimal switching strategy for the traffic lights based on the state of the pod network while ensuring full compliance with traffic light regulatory standards.
- *Experimental validations:* The selected control laws will initially be validated through numerical simulations and, if possible, implemented experimentally on the Tomblaine trial circuit in the suburbs of Nancy.

This postdoc will be funded by the ANR COMMITS project involving CRAN (Nancy), LORIA (Nancy), CNAM (Paris), and, of course, Urbanloop (Nancy).

Job profile

We are looking for a candidate holding a PhD in control engineering, preferably with an expertise on multi-agent or interconnected systems.

To apply or for any information, please contact Jérémie Kreiss (jeremie.kreiss@univ-lorraine.fr) or Vineeth S. Varma (vineeth.satheeskumar-varma@univ-lorraine.fr) with your CV.

References

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