Seminário em Engenharia Matemática

Orador: Amélia Caldeira – LEMA/ISEP
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Sala: H211

PATH-FOLLOWING OF VEHICLE FORMATIONS USING MODEL PREDICTIVE CONTROL

Abstract:
In this talk we propose a control scheme for a set of vehicles moving in a formation.
Over the last few years, formation control of multiple vehicles has received an increasing attention from the control community. The task is to control a group of mobile robots to follow a predefined path or trajectory, while maintaining a desired formation pattern. In this seminar we propose a control scheme for a set of vehicles following a path in a formation.
The control methodology selected is a two-layer control scheme where each layer is based on a sampled-data Model Predictive Control (MPC) scheme.
The reason why two-layers are used in the control scheme is because there are two intrinsically different control problems:

- The path-following control problem: devise a trajectory, and corresponding actuator signals, for the formation as a whole;
- Maintain the formation: change the actuator signals in each vehicle to compensate for small changes around a nominal trajectory and maintain the relative position between vehicles.

These control problems are intrinsically different because, on the one hand, the vehicles considered (cars, planes, submarines, wheeled vehicles) are nonholonomic (cannot move in all directions instantaneously). On the other hand, while the vehicles are in motion, the relative position between them in a formation can be changed in all directions (as if they were holonomic).
We address the path-following problem by converting it into a trajectory -tracking problem and determine the speed profile at which the path is followed inside the optimization problems solved in the MPC algorithm. The MPC framework will solve a sequence of optimization problems that will find an initial point, a speed profile, and a feedback control to track the trajectory of a virtual reference vehicle, i.e., the MPC framework will find a feedback control to follow the path given. The method is illustrated in a simple differential-drive mobile robot.

This is joint work with Fernando A. C. C. Fontes (ISR-Porto e FEUP)

References:

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- Fontes, F., Fontes, D., Caldeira, A., **Obstacle avoidance in optimal switching of a formation geometry**. In Proceedings of CONTROLO-2012, 10th Portuguese Conference on Automatic Control, University of Madeira, 2012.
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