PhD Proposal 2017

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Title: Distributed Control of Multi vehicle Systems
● **Scientific field: Mathematics- Automatic control.**
● **Key words: Distributed, Cooperative Control, Multi vehicles Systems.**

Details for the subject:

Background, Context:

In recent years, cooperative control of multiple vehicles has been receiving significant attention owing to many potential advantages of such systems over single vehicle. In fact, multiple vehicles cooperative control means a group of vehicles working cooperatively that can achieve great benefits including low cost, greater flexibility, adaptability to unknown environments, and robustness. In the field of cooperative control, formation control has received a lot of attention from the researchers for its potential applications such as surveillance-and-security, object transportation, object manipulation, search-and-rescue, intelligent transportation systems, and exploration. The formation control means the problem of controlling the relative position and orientation of vehicles in a group according to some desired pattern for executing a given task.

To coordinate with other vehicles in systems, each vehicle needs to share information with its neighbors so that all can agree on common goal of interest, e.g. the value of some measurement in a sensor network, the heading of a vehicle formation, or the target position of vehicles team. Because of the interdisciplinary nature of the field, the study of distributed cooperative control problem of multiple vehicles systems has attracted increasing attention from researchers in various fields of physics, mathematics, Automatics, engineering, and sociology.

Research subject, work plan:

The main objectives of this project are both theoretical and practical. From a theoretical point of view, new algorithms for distributed cooperative control of multiple vehicles systems will be proposed. A class of stability conditions will be given. From a practical point of view, vehicles experiment platforms of the autonomous vehicles formation will be developed. These platforms will be used to validate the old ones and new results obtained.

There have many tasks which need to be considered in next year.

Task 1: Cooperative control of multiple vehicles based on Neural network

The nonhonolomic vehicles are not only described by kinematics, but also described by their dynamics due to theirs uncertainties and unknown disturbances, such as payload, friction coefficients, unmodeled dynamics, measurement error, and changes in environment and so on. It is difficult to obtain the precise mathematic model of the dynamics of the mobile vehicles. Hence, the neural network is introducing to overcome this problem, by its on-line learning ability and universal approximation property. According to different cooperative tasks, the kinematic control algorithm and torque control algorithm should be incorporated to improve the effective of multi- vehicle systems both from the viewpoint of performance in accomplishing certain tasks and in the robustness and reliability of the system.

Task2: Platform of Multiple vehicles

From a practical point of view, 2D and 3D experiment platforms of the autonomous vehicles group formation will be developed. These platforms will be used to validate the old our theoretical results and new results obtained. The platform for cooperative control of vehicles group formation need to be developed. The experiments platform suits for completing a variety of tasks by different types of mobile vehicle in unstructured environment. Key technologies such as vehicle sensing, communication, control, planning and collaboration unified are integrated, so that the vehicle team can form a mobile wireless network system, to complete the formation of multiple vehicles, cooperative navigation, positioning, football playing and other team tasks. Software is designed with ease of use, graphical, reusability, scalability, and so on.

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