Title : Open Invited track on cooperative control and navigation for UAVs

Proposers:

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Abstract:

The use of multiple UAVs for performing a global task is potentially beneficial because of the reduction of embedded equipments required for each vehicle, increased ability and robustness to failure. Management of fleet makes it necessary to develop sense and avoid techniques to insure safety, dynamical task allocation and procedure for exchange of information. These methods must be designed in order to limit the complexity (in terms of communication, relative estimation and distributed control design) and to increase the ability of the fleet to execute complex missions. Over the last few years, increased interest in these topics has led to rapid progress both in theory and practice in various fields such as communication, networks, guidance design or multi-agent modelling. The purpose of this session is present state of the art and recent developments in these research fields and illustration of feasibility through experiment results.

IFAC TC for evaluation: TC 7.3 Transportation and Vehicle Systems/ Aerospace

Description of the topic: Missions such as large area surveillance or multiple target tracking may often prove tedious, potentially dangerous or cumbersome for a human operator. Using autonomous, or at least partly autonomous, vehicles could greatly contribute to making these missions feasible. However, their complexity may prove very demanding in terms of technological requirements for a single vehicle. Splitting the task into several subtasks makes it easier to fulfil the demands. It is thus necessary to determine how the subtasks are defined and to which vehicles they are attributed. Two approaches can be defended. The first one consists in defining subtasks that do not interfere, but whose collection leads to mission achievement. The second one is aimed at defining nested subtasks whose coordinated achievements would be at least equal, but possibly greater, than those of a complex but unique vehicle. This approach, known as cooperative tasking, requires coordination of the entire vehicle set to guarantee the satisfaction of the initial mission needs. The determination of specific control laws and estimation procedures are required to enable vehicles to perform cooperative tasks. This field of research has been very active since the 1980's and encompasses theories from various domains, such as game theory, artificial intelligence or distributed control. The numerous existing approaches vary according to the type of mission and the associated requirements in terms of constraints on formation flying, communication exchange or allocation of resources. Many issues must be addressed, from the modelling of the cooperative set of vehicles, the definition and management of the allocated tasks and required information, and the definition of cooperative control strategies enabling the coordination and safety of these vehicles.

This open invited track aims to address but does not limit to the following themes and topics

- Distributed modelling of fleet
- Decentralized control and communication in cooperative tasking
- Cooperative location and tracking with communication constraints

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- Sense and avoid techniques in formation fleet
- Cooperative guidance with dynamical task allocation
- Experiments and demonstrations of feasibility on multi UAV systems

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