Title: Open invited track on Hybrid Control Synthesis for Multi-Robot Systems

Proposers:

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Abstract: Recent developments in hybrid control synthesis for single-robot systems have enabled the consideration of rich objectives and at the same time provable guarantees on their satisfaction, both in static and dynamic environments. The adoption of this framework in multi-robot systems is, however, not straightforward. While centralized approaches are computationally infeasible, distributed approaches are challenging due to dependencies between the agents and collaborative nature of the desired tasks. This invited track aims to present recent advances on the fusion of cooperative control and discrete task planning in multi-robot systems leading towards an efficient, distributed, adaptive control synthesis framework for multi-agent systems with rich objectives.

IFAC TC for evaluation: 1.3 Discrete-event and hybrid systems

Description of the topic: Research in multi-robot control systems has been traditionally focusing on control objectives such as stabilization and tracking, and many different approaches have been considered, ranging from graph theoretic based methods to geometrical approaches. Recently, task planning and control with respect to a much richer set of potential objectives has been addressed, such as combinations of surveillance ("periodically visit region A"), sequencing ("visit region A, then B, then C"), safety ("always avoid region D"), and many others, e.g. [1-6]. These complex objectives can be often well-addressed at the discrete level using automata and formal verification and synthesis tools from computer science. The fusion of the research themes of multi-agent control at the continuous level and task planning at the discrete level naturally entails a *hybrid systems control framework*. Moreover, developments in sensing and communication capabilities of robots call for new approaches to *adaptive task planning and control* every time new information about the environment is gathered. The robotic agents need efficient ways to interpret and adapt to the new information and reconfigure their plans accordingly [7,8]. The need for methodologies for higher level specifications that allow multi-robot systems to perform task planning accordingly and also take into account updated sensing and communication information thus becomes apparent. At the same time, continuous-time control needs to involve both coupled constraints between the agents as well as driving the members of the multi-agent team to a desired configuration in the state space. Plugging in the distributed nature of the problem, several emerging questions arise on the blending of cooperative multi-agent control and discrete task planning in a distributed hybrid systems fashion.

This open invited track aims at, but does not limit to, the following themes and developments in the field of planning and control for multi-robot systems.

- Logic-based task specification formalisms for multi-agent systems
- Formal abstractions of multi-agent systems
- Compositional control synthesis
- Approaches to distributed cooperative task allocation and execution
- Real-time adaptive planning and control under complex task specifications

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