SOUTENANCE DE THÈSE

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Soutiendra sa thèse de **Doctorat** sur le sujet :

Cooperative Multi-UAV System for Collective SLAM-based Exploration

Dans l'Unité de Recherche :

HEUDIASYC UMR CNRS 7253

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devant le jury composé de :

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Abstract

In the aerial robotic community, a growing interest for Multi-Robot Systems (MRS) appeared in the last years. This is thanks to \textit{i)} the technological advances, such as better on-board processing capabilities and higher communication performances, and \textit{ii)} the promising results of MRS deployment, such as increased area coverage in minimum time. The development of highly efficient and affordable fleet of Unmanned Aerial Vehicles (UAVs) and Micro Aerial Vehicles (MAVs) of small size has paved the way to new large-scale applications, that demand such System of Systems (SoS) features in areas like security, disaster surveillance, inundation monitoring, search and rescue, infrastructure inspection, and so on. Such applications require the robots to identify their environment and localize themselves. These fundamental tasks can be ensured by the exploration mission. In this context, this thesis addresses the cooperative exploration of an unknown environment sensed by a team of UAVs with embedded vision. We propose a multi-robot framework where the key problem is to cooperatively choose specific regions of the environment to be simultaneously explored and mapped by each robot in an optimized manner in order to reduce exploration time and, consequently, energy consumption. Each UAV is able to perform Simultaneous Localization And Mapping (SLAM) with a visual sensor as the main input sensor. To explore the unknown regions, the targets -- selected from the computed frontier points lying between free and unknown areas -- are assigned to robots by considering a trade-off between fast exploration and getting detailed grid maps. For the sake of decision making, UAVs usually exchange a copy of their local map; however, the novelty in this work is to exchange map frontier points instead, which allow to save communication bandwidth. One of the most challenging points in MRS is the inter-robot communication. We study this part in both topological and typological aspects. We also propose some strategies to cope with communication drop-out or failure. Validations based on extensive simulations and testbeds are presented.

Keywords: coordinated multi-robot, autonomous exploration, frontier-based exploration, SLAM, inter-robot communication.