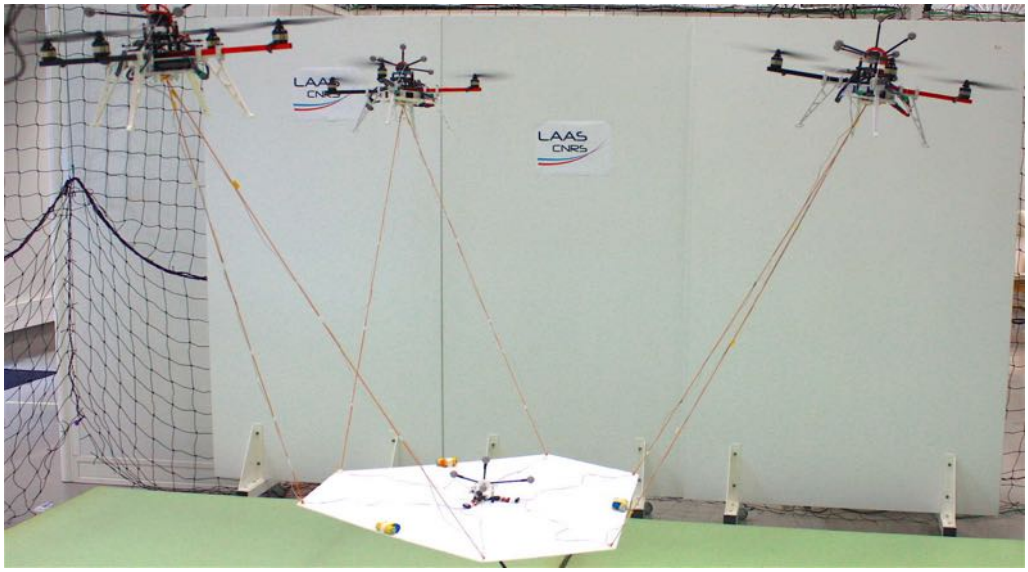
Master Thesis Project Title: Development of a HMI for the operation of a robotic aerial manipulator

Project Supervisors:
Name: Juan Cortés, Antonio Franchi
Group: Robotics and InteractionS (RIS)
Institution: LAAS-CNRS, Toulouse, France
email: juan.cortes@laas.fr, antonio.franchi@laas.fr
web page: www.laas.fr, https://homepages.laas.fr/afranchi/robotics/

Summary:
The Robotics and Interactions (RIS) group of LAAS-CNRS is developing a novel robotic aerial system, capable of manipulating (controlling both position and orientation) objects in the air. The system, which we call FlyCrane, is composed of three aerial robots attached to a platform by three pairs of cables (see image below). The FlyCrane has significant advantages over existing systems for transporting loads using helicopters, mainly safety, robustness and accuracy. The applications of such a system are numerous: construction/assembly in areas difficult to access, rescue missions in dangerous areas, … In recent years, we developed motion planning and control methods for the FlyCrane [1], and we did a proof of concept with an indoor prototype, using quadrotors. We are currently building a lager prototype, using hexarotors, for outdoor experiments.



Our next goal is to develop methods allowing the teleoperation of the FlyCrane. Indeed, for most applications, and because of legal constraints, it may be preferable to put in the loop an operator to guide the system and/or locally modify the planned trajectories. However, an operator would not be able to pilot a system as complex as the FlyCrane without the help of algorithms. Therefore, we aim to develop a human-machine interface (HMI) allowing the operator to easily control the pose (position and orientation) of the transported/manipulated object, and to use control algorithms to adapt the state of robots automatically in real time.

The main objective of this project is to design and implement the HMI and associated software to facilitate teleoperation. The HMI will be composed of a remote control system and a screen (e.g. a tablet) to provide visual information to the operator aiming to increase security. For example, sensor information about the proximity to obstacles or engine saturation will be displayed on the tablet to alert the operator of a possible danger.

References:
[1] M Manubens, D Devaurs, L Ros, J Cortés, Motion planning for 6-D manipulation with aerial towed-cable systems, *Robotics: Science and Systems* (RSS), 2013

Expected skills:
Excellent programming skills are mandatory (mainly C++). Experience with human-machine interfaces (HMI) and graphical user interfaces (GUI). Knowledge about 3D modeling, kinematics, dynamics and control methods would be an important plus.

Possibility of funding:
The student will be provided with a monthly stipend of around 550 euros during up to six months.

Applications:
Please send an email containing your CV to Juan Cortés (juan.cortes@laas.fr) and Antonio Franchi (antonio.franchi@laas.fr), indicating in the subject “Candidate HMI project”.