# Programme de la réunion

GT UAV « Véhicules Aériens Autonomes »
GdR MACS et GdR Robotique

# Asservissement visuel et vision pour les drones aériens

Jeudi 12 novembre
ENSAM Paris, Salle P2
Boulevard de Hôpital, Paris 13ème

9h15 : **Accueil et café**

9h30 – 10h30 : **François Chaumette** (INRIA Rennes-Bretagne Atlantique - IRISA)
***Recent Advances in Visual Servoing***
Abstract :
Visual servoing techniques consist in using the data provided by a vision sensor in order to control the motions of a dynamic system. A large variety of positioning tasks, or mobile target tracking, can be implemented using this approach. Whatever the sensor configuration, which can vary from one on-board camera on the robot end-effector to several free-standing cameras, a set of visual features has to be selected at best from the image measurements available. A control scheme has then to be designed so that these visual features reach a desired value, defining a correct realization of the task.

With a vision sensor providing 2D measurements, potential visual features are numerous, since as well 2D data extracted directly from the images as 3D data provided by a localization method can be considered. It is also possible to combine 2D and 3D visual features to take the advantages of each approach while avoiding their respective drawbacks. From the selected visual features, the behavior of the system will have particular properties as for stability, robustness with respect to noise or to calibration errors, robot 3D trajectory, etc.

The talk will present the main basic aspects of visual servoing, as well as recent advances obtained recently in the field inside the Lagadic group at INRIA Rennes-Bretagne Atlantique - IRISA. Several application results, especially those obtained recently on aerial vehicles, will be also described.

10h30 – 11h30 **: José-Raoul Azenheira** (IST, Lisbonne)
***Homography based visual servoing for an aircraft approach and landing***
Résumé :
Travaillant sur des thèmes de commande du vol et robotique aérienne depuis 1998, José Raul Azinheira présentera l'approche d'asservissement visuel par homographies proposée dans le cadre du projet Européen PEGASE pour l'approche finale et atterrissage automatique d'un avion.

11h30 – 12h30 : **Sébastien Clerc** (Thales Alenia Space)
***Crater Detection and Identification for Autonomous Optical Navigation of Interplanetary Vehicles***. S. Clerc, M. Spigai, P. Lanza.

Abstract :
Future interplanetary exploration missions to the Moon, Mars or other Solar System bodies will require ever more precise landing capabilities. The goal is to be able to reach a goal of scientific interest (e.g. a Martian methane source) or operational interest (e.g. a sunlit crater rim on the Moon). Achieving precisions of the order of 100 m on the Moon or 1 km on Mars will require innovative autonomous navigation technologies, beyond pure inertial navigation. Optical navigation has been recognized as a promising path because of the light weight and low power requirements of cameras. However optical navigation requires complex algorithms. This is an issue for space missions using radiation-hardened computers with limited computational power.

Vision-based position navigation consists in determining the position of the lander using images acquired during the descent and an on-board model of the terrain. The position can be determined using either local features (low-level texture elements in the image) or global features (high-level geographic landmarks). Fortunately, surfaces of solar system bodies without a dense atmosphere offer a profusion of landmarks with a very distinctive visual signature: impact craters.

Image processing techniques already tested for autonomous crater detection are Hough-transform or edge based and require generally high computational power and are sensitive to noise. The present work proposes a new method based on image segmentation techniques used for scene analysis and target recognition with Earth Observation satellite images.

12h30 – 14h00: **Déjeuner**

14h00 – 15h00 : **Jean-Christophe Zufferey** (Ecole polytechnique fédérale de Lausanne, Suisse)
***Low altitude flight and collision avoidance using optic flow***
Abstract:
Flying in the vicinity of obstacles while avoiding collisions remains highly challenging for small aerial vehicles, which cannot carry heavy sensors. When compared to heavy active ranging techniques such as ultrasound, lidar, or radar, vision constitutes a very promising alternative. In this talk, I will describe a new control strategy named optiPilot, which relies on optic flow to fully control the flight, avoid collisions with the terrain and obstacles, autonomously take-off, land, and steer towards some defined location.

15h00 – 16h00 : **Isabelle Fantoni** (Heudiasyc, Université de Technologie de Compiègne)
***Commande utilisant le flux optique pour la navigation réflexe d'un hélicoptère à quatre rotors***

La navigation autonome d'un véhicule aérien sans pilote (UAV) peut être obtenue à l'aide d'un système réactif ou réflexe qui permet au véhicule de dépasser tous les changements imprévus dans son environnement. Une nouvelle approche d'évitement d'obstacles frontaux sera présentée utilisant les propriétés connues du flux optique et profitant de la capacité du vol stationnaire de l'hélicoptère. Une machine d'état est proposée comme solution pour équiper le drone de toutes les réactions nécessaires pour la navigation en intérieur. Les transitions sont effectuées en douceur par diminution de la vitesse du véhicule proportionnellement à la distance d'un obstacle et par brefs instants de vol stationnaire.

16h00 – 17h00 : **Table ronde : activités et projets du GT**