

Dr. Paolo Robuffo Giordano  
IRISA-CNRS/INRIA  
Campus Universitaire de Beaulieu  
35042 Rennes cedex, France  
Email: [prg@irisa.fr](mailto:prg@irisa.fr)

The **Lagadic** group at **INRIA/IRISA-CNRS** Rennes, France

<http://www.irisa.fr/lagadic/welcome-eng.html>

has **two open PhD positions** in the field of **visual-based navigation and control for UAVs**.

## PhD TOPICS

### 1) Visual predictive control for UAVs

#### DESCRIPTION

Visual servoing is a well-known class of techniques meant to control the pose of a robot from visual input by considering an error function directly defined in the image (sensor) space. These techniques are particularly appealing since they do not require, in general, a full state reconstruction, they typically grant good robustness against miscalibrations and model inaccuracies, and are computationally cheap w.r.t. a full state estimation step.

The goal of this PhD scholarship is to investigate how to exploit the visual servoing framework for effectively controlling the pose of a quadrotor UAV equipped with an onboard camera IMU and embedded processing power. The intended applications span precise positioning over ground (moving) objects, trajectory following and formation control. Because of the quadrotor underactuation and inherent sensor limitations (mainly limited camera fov), a special emphasis will be placed on the use of model predictive control techniques (or similar ideas) for explicitly dealing with this kind of constraints during flight.

A full, sound (and onboard) implementation of all the developed schemes on the quadrotor platforms available in the group will also be part of the PhD goals.

#### CANDIDATE'S EXPECTED PROFILE

The ideal candidate is expected to have a strong background in the field of robotics, estimation and control. Familiarity with quadrotor flight control, visual-based control, predictive/optimal control, optimization, image processing are a plus.

The candidate must be a proficient user of C/C++ and ROS. Familiarity with matlab/simulink is a plus. Scientific curiosity, autonomy and ability to work independently are also expected.

A M.Sc. degree in computer science, engineering, applied mathematics (or related fields) is required. UE or Swiss nationality is also required for applying to this position.

## **SALARY**

Full-time 3-year position paid according to French salary schemes.

## **2) Robust visual state estimation and sensing for UAVs**

### **DESCRIPTION**

The goal of this PhD position is to develop robust (and real-time) computer vision algorithms for recovering the "state" of a quadrotor UAV from onboard sensing (mainly 2D/3D cameras and IMU) and processing power. Here, the term "state" serves as a placeholder for, e.g., relative position w.r.t. other UAVs in the scene, identity of neighboring UAVs, relative position w.r.t. surrounding obstacles, velocity over ground, and so on. In summary, any relevant information needed for controlling the quadrotor motion over ground, for avoiding obstacles, and for keeping desired relative displacements with nearby quadrotors (for the sake of formation control).

The developed algorithms should possess a good degree of robustness w.r.t. real-world conditions, for instance by avoiding, as much as possible, the use of special markers or other artificial aids for segmenting the environment or neighboring UAVs. While the main application will be indoor flight, extension to outdoor scenarios will also be considered.

### **CANDIDATE'S EXPECTED PROFILE**

The ideal candidate is expected to have a strong background in the field of computer vision (for robotics applications), image processing and pattern matching/classification. Familiarity with the use of vision in the context of quadrotor navigation/flight control (e.g., visual odometry, visual SLAM) is a plus.

The candidate must be a proficient user of C/C++, ROS, and of the relevant computer vision libraries (ViSP, OpenCV, PCL). Scientific curiosity, autonomy and ability to work independently are also expected.

A M.Sc. degree in computer science, engineering (or related fields) is required. No restriction on the candidate's nationality is present for this position.

## **SALARY**

Full-time 3-year position paid according to French salary schemes.



## ENVIRONMENT

The Lagadic group, headed by Francois Chaumette,

<http://www.irisa.fr/lagadic/welcome-eng.html>

is internationally recognized for its scientific activity as well as for technology transfer experiences in the field of visual tracking, visual servoing, computer vision and sensor-based control for robotics applications. The facilities available in the group include three 6-dof manipulator arms, a pioneer indoor mobile robot, a state-of-the-art human-size humanoid robot (Romeo), a fleet of quadrotor UAVs, and an indoor large testing arena instrumented with Vicon.

Both candidates will be under the supervision of [Dr. Paolo Robuffo Giordano](#) and will work in close collaboration with other members of the Lagadic group involved in the project.

The Lagadic group is part of the Inria/Irisa lab that spreads its activities in 30 research teams working in computer science, signal processing, and control. It involves about 650 people, including 120 professors and assistant professors, 100 full-time researchers, 80 administrative staff, and 250 PhD students.

## HOW TO APPLY

Interested candidates must send to Dr. Paolo Robuffo Giordano (prg [at] irisa.fr) the following material:

- motivation letter
- detailed CV
- name of at least two referees
- any relevant information for proving a good match with the PhD description and expected profile of the candidates

Both positions will remain open until a satisfactory candidate will be found.