

PhD Studentship: *Reliable and energy-efficient data collection in a complex environment through a team of autonomous aerial vehicles*

UGA Supervision:

[Assoc. Prof. Ionela PRODAN](#), Univ. Grenoble Alpes, Grenoble INP, LCIS (Laboratory of Conception and Integration of Systems), Valence, France

UCL Supervision:

[Dr. Francesca BOEM](#), Univ. College London, Dept. of Electronic and Electrical Engineering, Faculty of Engineering Science, London, UK.

[Dr. Laura TONI](#), Univ. College London, Dept. of Electronic and Electrical Engineering, Faculty of Engineering Science, London, UK.

Starting date: Fall 2020

Duration of study: Full Time- three years fixed term

Gross Monthly Salary: ~1,870 EUR.

Eligibility: students from the EU or Switzerland,

Keywords: Motion planning, Coordination, Unmanned Aerial Vehicles (UAVs), Robust optimization based control, Wide sensor network, Reinforcement learning.

A fully-funded PhD studentship is available to **EU or Switzerland students** at the Univ. Grenoble Alpes doctoral school within the project of *machine learning algorithms for immersive communication*. The studentship is available from 1st October 2020, for a period of three years. The student will be officially enrolled in the Univ. Grenoble Alpes doctoral school under the supervision of Prof. Ionela Prodan, in a joint collaboration with the Department of Electronic and Electrical Engineering at UCL (supervisor Dr. Francesca Boem, Co-Supervisor Dr. Laura Toni).

This thesis aims to provide a reliable framework within which information from a complex environment is gathered through a mesh of fixed ground sensors and a mobile team of Unmanned Aerial Vehicles (UAVs). Communication and power-limited sensors gather and store information about the environment. The sensors communicate on small scale and can group either through emergent behaviour or in a supervised manner into clusters such as to minimize the overall communication within the ground network. Thus, only the cluster heads are required to spend energy by communicating with the UAVs. A *motion planning mechanism* (including trajectory generation and tracking) provides robust trajectories which ensure passing near the cluster heads, avoids forbidden regions and minimize time and energy costs for the UAVs. The variability of the scheme imposes additional considerations: time near the cluster heads depends on the quantity of data to be sent; cluster heads may alternate within a cluster such as to spread the energy costs, etc. *Advanced control strategies* will ensure robustness against disturbances and fault events

with guaranteed trajectory tracking. Centralized and distributed task allocation within the UAV team will be considered. The former entails a common supervisor and the later requires consensus strategies and increased autonomy. *Reinforcement learning* (decision making strategies able to cope with the uncertainties/ unpredictability [2]) are used for both data aggregation (such that only relevant features are sent to the UAVs thus reducing communication costs) and motion planning (such as to provide near-optimal paths respecting the various associated constraints and costs). Precision agriculture applications [6] will be considered as they exhibit multiple interesting features.

To summarize, the expected results of this thesis are:

- the development of a framework (theoretical tools, a toolbox gathering the algorithms) to generate offline trajectories with constraint and cost validation;
- the reduction of operating costs, increase of the viability and flexibility of operation of drones in typical use cases;
- the validation of the results in experimental tests, similar to the missions required by commercial entities (e.g., for precision agriculture applications).

Applicants must hold, or be near completion, of a first or upper-second class degree in Engineering or a related subject. An understanding of automatic control, automation and intelligent systems is required. The ideal candidate would also have a strong interest in computer programming, and machine learning. We are seeking candidate with the potential to engage in innovative research and to complete the PhD within a three-year period of study. Fluent English is also required.

Also, the candidate is expected to:

- Have excellent analytical and engineering skills
- Have excellent reporting and communication skills
- Be self-motivated, independent and team player
- Have genuine enthusiasm for the subject and technology
- Have the willingness to travel from France to UK when necessary
- Have the willingness to author and publish research findings in international journals

How to apply

Interested applicants are encouraged to make Informal enquiries about the post to Prof. Ionela Prodan at ionela.prodan@lcis.grenoble-inp.fr.

Formal applications should be submitted with a CV, a brief statement of your research interests, and with names and email addresses of two referees to Prof. Ionela Prodan at ionela.prodan@lcis.grenoble-inp.fr.