

## **PhD thesis position proposal in the context of the UrbanFly project**

# Agent-based modeling of drones and their environment in smart cities

**Keywords :** Control model of drones, agent-based simulation, semantic model of the environment,

## **1. Administrative Information**

**Scientific Field:** Computer Science

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**Start date of the PhD thesis :** October, 1st 2017

**Location of the PhD works :** Université de Technologie de Belfort-Montbéliard. 13 rue Ernest-Thierry Mieg 90010 Belfort cedex

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## **1. Context**

Decrease in the production costs of unmanned aerial vehicles, sensor and actuator equipment, and recent technological advances make FV easily available for industrial and private usage. Drones are an emerging technology of unmanned aerial vehicles (UAVs) which combine two major branches of the FV - remotely piloted aviation systems (RPASs) and fully autonomous vehicles. Academics and industry are investing essential resources into constructing UAV and estimating their societal and economic impacts. However, numerous aspects of this quickly maturing technology remain uncharted and the future of the urban UAV-traffic is not clear at all. The current market share of civil government and commercial use is relatively small when compared to military, 56M€ or 0.94% of market share in 2014. However, the forecasts agree about the rapid growth of the civilian use of UAVs and their economic impact and according to a Teal Group world civil UAV market is predicted to reach 9.85% (\$1088 million) of the global UAV

market by 2023. The UAV are already intensively used in agriculture, aerial photography, surveying, law enforcement, advertising, and, more recently, in construction safety, package and food delivery. Major industry players like Amazon, DHL and Google are already testing and using UAVs for various civil purposes, e.g. package deliveries. The former Mayor of London Boris Johnson called for UAV package delivery solutions to help solve the city's congestion problem. The goal of project is to provide tools and recommendations for the UAV urban traffic in respect to the: (i) infrastructure design, (ii) aerial traffic management, and (iii) rules and regulations to citizens, local authorities, and other stakeholders, including aviation agencies, that have already reached the **Technology Readiness Level (TRL) 6**.

## 2. Goals of the PhD Thesis

The goal of this PhD thesis work is the proposal of a methodology and a design model in order to model and simulate drones inside a virtual smart city. The proposed methodology will provide the guidelines and the framework in order to help the designer to create the models of the drones and the environment. The proposed simulation models should be realistic enough to enable their deployment on real drones.

Two axes are considered :

1. The model of the smart city environment supporting 3 spatial dimensions and informed environments.
2. Building the models and the algorithms that will enable the control of the drones inside the proposed environment.

### Models, Methodology and Tools

From the state of art, a set of fundamental concepts and formalisms adapted to drone and environment modeling will be identified. In order to understand the complexity of the system, these concepts and languages should allow the description system of systems, complex hierarchies of components integrating heterogeneous models from different disciplines.

These tools will serve as the basis for the elaboration of a methodology that will be specific to the modeling and the implementation of the existing drone models, and to guide us to the definition of new models for their integration in smart cities.

The PhD works should contribute to the identification and specification for the development of tools that are adapted to each of the phases of the methodology previously defined. It is very likely that none of the existing tools will cover the entire methodology. It may be necessary to develop software modules that are facilitating the modeling of the urban environment and the reproduction of the dynamic behaviors of the drones.

### Simulation Demonstrator

In order to validate the proposed models and methodology, the PhD student will have to create a demonstration simulator in collaboration with the other members of the Research team. This demonstrator will be composed by an agent-based simulator, e.g. <http://www.sarli.io>, drones algorithms, and environment models. The control algorithms will be deployed on real drones.

### 3. Relation to the Research Strategy of the team

**Projects in the Research team that have links to this PhD thesis** : Dronity (H2020), SARL ([www.sarl.io](http://www.sarl.io)), JANUS ([www.janusproject.io](http://www.janusproject.io)).

### 4. References.

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### 5. Candidate and Application

#### **Expected profile et background for the candidate:**

The candidate should have a strong knowledge in agent-based modeling or semantic modeling, in software engineering (simulation, performance evaluation) and in computer programming (SARL and Java programming languages).

**Minimal French Level :** not considered if the English level is excellent; otherwise good

**Minimal English Level:** good

**Application due date:** May 31st 2017