Towards the Agent-based Simulation of Unmanned Aerial Vehicles in a 3D Environment

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Abstract.

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 [Val07] – 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 [Che12]. 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% ($1,088 million) of the global UAV [Tea14].

However, the future of the urban UAV-traffic is not clear [Gar13]. We propose a methodology and a model in order to simulate drones inside a virtual smart city. This model will be used by stakeholders for predicting the behavior within the system against new regulations. Because this system is intrinsically distributed, the *agent modeling paradigm* is used [RGG14].

Figure 1 presents the architecture of the proposed agent simulator. According to [SCGK15, GBG+15], the system is divided into three inter-connected components: (i) the smart city model, which contains the geometrical and semantic definitions of the city elements (buildings, smart sensors...). This model includes a simulation of the weather conditions; (ii) the drone agents, which are controlling the drone

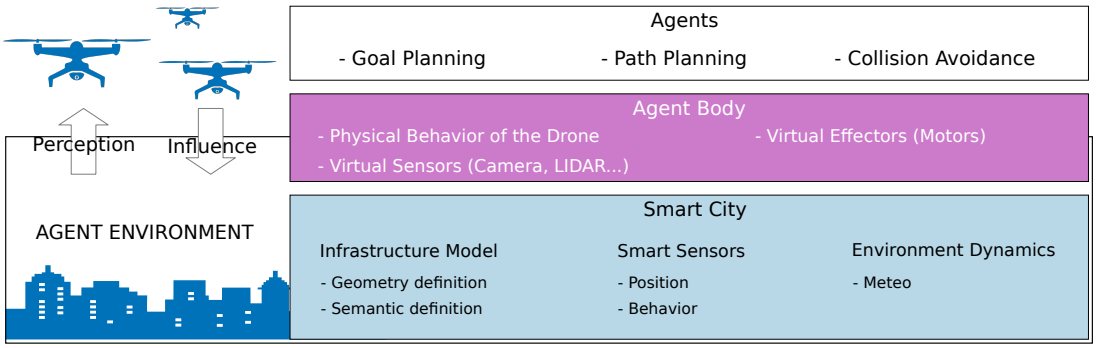

Figure 1: Architecture of the Agent-based Simulation of Drones

by determining the goal to reach, the path to follow, and by avoiding collisions with other objects; (iii) the agent body, which embeds the physical properties of the drone, and provides its physic-based model. A realistic motion of the drone in the air is simulated with this later.

The SARL agent programming language[1] [RGG14], and its run-time environment Janus are used for developing and deploying the agents. The Gazebo drone simulator is used for simulating the physical behavior of the drones by applying the Newton's laws from the drone's properties and the weather model.

The next step of this work is the definition of the control behaviors for each drone. It will consist in the definition of an agent's behavior that will enable the drone to select the safest path through the air in order to reach its goal. Moreover, the modeling process will be defined in order to provide to the stakeholders the methodology for designing a simulation model for drones.

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