



Special issue on “drones as enablers of novel services: operational and technology challenges”

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1 Introduction

Unmanned Aerial Vehicles (UAVs) - based applications and services are no more a remote possibility but an economic and social opportunity. Emergency-response coordination, infrastructure monitoring, urban planning, security, logistics or support for intelligent transportation systems are only some of the domains in which UAVs may become key in the near future. In particular, drones-in-the-city will become aerial sensing platforms that will be integrated into urban sensing networks, and the data they generate will be merged with the data flow coming from existing sensors through IoT platforms, to deliver new services and support innovative business models. Apart from the legislative changes needed to make urban drone-based applications feasible, it is essential to ensure the efficient and safe operation of UAV fleets within a restrictive and complex operating area. It is also important to enable the accurate acquisition, secure transmission and correct interpretation of drone-gathered information to allow new applications and business models to develop.

This Special Issue aims to bring together contributions that examine the operational, business and technology challenges that the use of drones poses. Eight articles cover different

topics related to operations planning, service provision, examples of services over drones (communications and monitoring) and UAV technology specificities (such as navigation improvement and drone image leverage). Following there is a brief summary of the specific contents of each article.

In “Drone Flight Planning for Safe Urban Operations”, by Juan A. Besada et al., it is described the requirements of a flight planning tool for safe urban operations, which may be used to design operations considering flight constraints and limitations. Additionally, authors show how the system is designed to work in coordination with an unmanned traffic management system (UTM) in charge of distributing available very low-level airspace resources among different operations and authorizing them, and of monitoring compliance of actual flights with flight authorizations.

In “A control and communications platform for procedural mission planning with multiple aerial drones”, by Bruno Areias et al., authors describe a modular solution for multi-drone control that implements the functionality required for planning, execution, and monitoring of procedural, multi-step missions with optional drone cooperation. The performance of drone-to-ground communications, with a particular focus on latency, is evaluated, together with the performance of commercial built-in message brokers, which seem not be suitable for drone swarms.

“Drones-as-a-Service: a Simulation-Based Analysis for On-Drone Decision Making”, by Majed Alwateer et al., includes an analysis on how a variety of drone applications (security, logistics and transport, surveillance, etc.) can be delivered as a service, using a common set of underlying service provisioning principals, such as making decisions about who to serve next. Authors also study by simulation how different decision-making strategies on drone flights impact clients and service providers.

In “On-Demand UAV Base Station Deployment for Wireless Service of Crowded Tourism Areas”, Lijie Yin et al. propose an on-demand coverage solution based on unmanned aerial vehicle (UAV) base stations to deal with the high demand that specific tourism-related events may require. The methodology includes defining the effective coverage

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radius, based on which the optimal altitude of UAV BS is derived, to then tackle the inherent challenge of irregular tour-ist flow through an automatic UAV BS deployment algorithm.

In “SwarmCity project: monitoring traffic, pedestrians, climate and pollution with an aerial robotic swarm”, Juan Jesús Roldán et al., propose a robotic swarm to collect the data of traffic, pedestrians, climate, and pollution. Data are sent to a base station, where they are treated to generate maps and presented in an immersive interface. To validate these develop-ments, authors use a virtual city called SwarmCity with models of traffic, pedestrians, climate, and pollution based on real data. Results show that the complete solution - i.e., fleet control, data fusion, and operator interface - allows monitoring the relevant variables in the simulated city.

Different technology issues related to UAV performance and capabilities are considered in the next three articles. “Simulation in real conditions of navigation and obstacle avoidance with PX4/Gazebo platform”, by Jesús García et al., presents an ap-proach to integrate and evaluate a LIDAR sensor and the capac-ity for improving navigation and obstacle avoidance functions in simulated situations using a real UAV platform. The proposed solution (a general method that could be used to integrate other kind of sensors) shows physical integration of the main types of sensors in UAV domain both for navigation and collision avoid-ance, and at the same time the use of powerful simulation models developed with Gazebo.

In “A Superresolution Enhancement of UAV Images based on a Convolutional Neural Network for Mobile Devices”, Miguel A. Patricio et al., focus on how to reconstruct high-resolution images given low-resolution images (image super-resolution, SR), proposing an architecture for the SR of im-ages captured by a UAV. The images are sent from a low-resolution camera in a UAV to a mobile device from which it is possible to obtain the corresponding SR image. A bench-mark dataset of images is used for both quantitative and qual-itative assessment.

“Aerial Image Super-Resolution based on Deep Recursive Dense Network for Disaster Area Surveillance”, by Feiqiang Liu et al., also tackle the production of high-resolution (HR) aerial images, in particular to monitor a disaster area from the air. Authors propose a deep recursive dense network (DRDN) to reconstruct HR aerial images. In the DRDN, the proposed recursive dense block (RDB) can fully extract abundant local features and adaptively fuse different hierarchical features of LR image for HR image reconstruction. In addition, the recur-sive manner of RDB in DRDN can effectively reduce the parameter of network. The experimental results on aerial im-ages demonstrate the superiority of our proposed method.

All in all, the compiled articles show the evolution of some hot topics in nowadays research related to drones and drone-enabled systems. In particular, it is interesting that some of the works are focused on delivering operational tools and services over urban spaces, which are assumed to be key to leverage

the potential of UAV in terms of services. A lot of open issues (related to traffic management, safety, privacy, pollution, ur-ban impact, user acceptance, etc.) are yet to be evaluated and explored to make drones-based applications a reality in these scenarios.

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Paper order

- Drone Flight Planning for Safe Urban Operations
- A control and communications platform for procedural mission planning with multiple aerial drones
- Drones-as-a-Service: a Simulation-Based Analysis for On-Drone Decision Making
- On-Demand UAV Base Station Deployment for Wireless Service of Crowded Tourism Areas
- SwarmCity project: monitoring traffic, pedestrians, climate and pollution with an aerial robotic swarm
- Simulation in real conditions of navigation and obstacle avoidance with PX4/Gazebo platform
- A Superresolution Enhancement of UAV Images based on a Convolutional Neural Network for Mobile Devices
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