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Information processing for unmanned aerial vehicles (UAVs) in surveying, mapping, and navigation

Unmanned Aerial Vehicles (UAVs) have been involved in a wide range of remote sensing applications. In particular, recent developments in robotics, computer vision, and geomatics technologies have made it possible to capture a huge amount of visual data with low-cost UAVs. As a kind of rapid, flexible and low-cost data acquisition system, UAVs have shown great potential to perform numerous surveying, mapping, and remote sensing tasks with extremely high-resolution data in low altitude flying and imaging conditions. However, such developments have also brought a plenty of challenges to the data processing for aerial remote sensing, photogrammetry, and geo-spatial information.

Recently substantial research has been devoted to the analysis of UAV data, e.g. understanding and modeling the urban environment with visual information from multiple sensors. The aim of this special issue of Geo-spatial Information Science is to develop new ideas, methodologies, and applications of UAVs for data analysis and remote sensing. The special issue includes seven papers that cover topics mainly on the navigation, image analysis, and surveying/mapping applications of UAVs.

Two papers focus on vision-based navigation of UAVs, which is important when UAVs work in complex environments, such as GPS-denied areas and degraded visual environments. The paper “A survey on vision-based UAV navigation” (by Lu et al.) provides a general literature review of the vision-based method for UAV navigation. It widely reviews works specifically on visual localization and mapping, obstacle avoidance and path planning, and shows the challenges and perspectives of vision-based UAV navigation. The paper “UAV navigation system using line-based sensor pose estimation” (by Li-Chee-Ming et al.) presents a mapping and tracking system by estimating the UAV’s pose in real-time using only the on-board RGB camera as the UAV travels through a known 3D environment. It enables a small Unmanned Aerial Vehicle (UAV) to accurately navigate (with sub-meter precision) in indoor and GPS-denied outdoor environments.

Three papers concentrate on the analysis of the images taken by UAVs, which are usually of great volume and suffer from degradations, such as blur and fish-eye effect distortion, due to the UAV platforms. The paper “Analysis of Large Scale UAV Images using A Multi-scale Hierarchical Representation” (by Yu et al.) proposes a multi-scale hierarchical representation, i.e. Binary Partition Tree (BPT), for analyzing large-scale UAV images. The paper “Log-Cumulants of the Finite Mixture Model and Their Application to Statistical Analysis of Fully Polarimetric UAVSAR Data” (by Deng et al.) proposes to use log-

cumulants statistics, which could be used to design parameter estimator or goodness-of-fit tests, to accurately analyze high-resolution fully Polarimetric UAVSAR images. The paper “Super-resolution enhancement of UAV images based on fractional calculus and POCS” (by Lei et al.) presents a super-resolution enhancement algorithm for UAVs’ images, for removing the motion blur, fish-eye effect distortion, and overexposed problems in UAV images.

Two papers study the applications of UAV system for surveying and mapping in some specific environments. The paper “Low-altitude geophysical magnetic prospecting based on multirotor UAV as a promising replacement for traditional ground survey” (by Parshin et al.) investigates the possibility of creating multirotor UAVs with special design to reduce magnetic interference of the flight platform, to obtain data at altitudes of 5 meters above the terrain even in a rugged relief. The paper “Unmanned aerial vehicles (UAV) for assessment of qualitative classification of Norway spruce health in temperate forest stands” (by Brovkina et al.) studies the potential of UAV-based remote sensing technique for monitoring of Norway spruce health condition in the affected forest areas.

This selection of papers in this Special Issue sheds a spotlight on the data processing of UAVs in the applications of navigation, surveying and remote sensing. We sincerely thank all the authors, whose contributions will further stimulate studies and applications in this dynamic research topic. We would also like to take this opportunity to sincerely thank reviewers for their valuable efforts and contributions.

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