UAV Multi-Sensor Payloads for High Precision Aerial Surveys

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SUMMARY

A variety of multi-sensor system payloads have been implemented onboard modern Unmanned Aerial Systems over the past decade for a variety of civilian applications including aerial surveying and mapping. The entire Surveying industry has been evolving by implementing drones in their daily surveying and mapping activities over the last decade. Some UAV payloads, however, necessitate the presence of numerous ground control points (GCPs) which almost defeats the purpose of surveying the land from the air.

This paper focuses on presenting the integration of professional-grade aerial survey sensors including GNSS, IMU, cameras, and LiDAR for high precision aerial surveys without the need for ground control points. The integration of the abovementioned sensors as a payload of a drone allows for precisely surveying any topography to produce a variety of 2D and 3D mapping products including orthomosaics, digital surface models (DSM), colorized point clouds, planimetric maps, topographic maps, etc. For a successful integration of a multi-sensor system as a drone payload, a number of integration parameters need to properly be addressed including individual sensor calibration (such as camera calibration) as well as spatial offsets (e.g., lever arms) and orientation misalignments (boresight), etc. Camera and/or LiDAR boresight calibration requires a certain flight pattern, processing mechanism, etc. This paper presents the best practice for system calibration.

To conduct a successful drone surveying mission, proper project planning, flight planning, data acquisition, data processing, quality assurance and quality control are all needed to end up with a successful, accurate, and consistent mapping product. Therefore, this paper will address the best practices for the entire recipe of high precision aerial survey by drones.

While presenting the best practice for system integration and calibration, the results of multiple

geometric accuracy assessment projects using different drones, cameras, and LiDARs that took place in the USA and Canada, from 2016 to 2022, are used.