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Accuracy analysis of a mobile mapping system for close range photogrammetric projects

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Abstract
Image-based mapping solutions require accurate exterior orientation parameters independently of the cameras used for a survey. This paper analyses the inclusion of up to two stereo-based geometric constraints in the form of baseline distance and convergence angle between camera axes to boost the integrated sensor orientation performance on outdoor close-range projects. A terrestrial low-cost mobile mapping GNSS/IMU multi-camera system is used to test the performance of the stereo-based geometric constraint on a weak geometric network in a stop-and-go survey. The influence of the number of control points (CPs) is analysed to confirm the performance and usability of the geometric constraints in real live terrestrial projects where far from ideal setups can exist across the survey. Improvements in image residuals up to 9 times and deviation errors better than 1 cm are expected when at least three CPs are incorporated into the adjustment.

Keywords: georeferencing, integrated sensor orientation (ISO), close range photogrammetry, mobile mapping, stereo-based constraints

1. Introduction

The integration of global navigation satellite systems (GNSS) such as GPS, Glonass, Galileo and Compass and inertial measurement units (IMU) with data acquisition sensors of different nature both optic (high resolution cameras, video-cameras and multispectral sensors) and non-optic (radar, laser scanner) are becoming essential tools especially in multi-sensor mobile mapping systems for navigation, georeferencing, surveying, updating databases and data flow optimization [1]. The concept of using GNSS/IMU for direct georeferencing of aerial images emerged in the 1980's and early 1990's [2]. Differential GNSS combined with high accuracy inertial systems were successfully used to determine the full exterior orientation for photogrammetry. Accurate direct georeferencing alleviated the need of ground control in object space and has long been optimised for mobile mapping systems that integrate multiple image-based and navigation sensors. At present direct georeferencing is used to determine the orientation of many sensors such as digital cameras, video-cameras, LIDAR and SAR. In many cases it is the only way to georeference the sensor.