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ONE-STEP AND TWO-STEP CALIBRATION OF A PORTABLE PANORAMIC IMAGE MAPPING SYSTEM

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Abstract. A Portable Panoramic Image Mapping System (PPIMS) is proposed for rapid acquisition of three-dimensional spatial information. By considering the convenience of use, cost, weight of equipment, precision, and power supply, the designed PPIMS is equipped with 6 circularly arranged cameras to capture panoramic images and a GPS receiver for positioning. The motivation for this design is to develop a hand-held Mobile Mapping System (MMS) for some difficult accessing areas by vehicle MMS, such as rugged terrains, forest areas, heavily damaged disaster areas, and crowded places etc. This PPIMS is in fact a GPS assisted close-range photogrammetric system. Compared with the traditional close-range photogrammetry, PPIMS can reduce the need of ground control points significantly. Under the condition of knowing the relative geometric relationships of the equipped sensors, the elements of exterior orientation of each captured image can be solved. However, the procedure of a system calibration should be done accurately to determine the relative geometric relationships of multi-cameras and the GPS antenna center, before the PPIMS can be applied for geo-referenced mapping. In this paper, both of one-step and two-step calibration procedures for PPIMS are performed to determine the lever-arm offsets and boresight angles among cameras and GPS. The performance of the one-step and two-step calibration is evaluated through the analysis of the experimental results. The comparison between these two calibration procedures was also conducted. The two-step calibration method outperforms the one-step calibration method in terms of calibration accuracy and operation convenience. We expect that the proposed two-step calibration procedure can also be applied to other platform-based MMSs.

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