An Innovative Image-Based Surveying Approach for Globally Referenced Remote Point Measurements

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Key words: Engineering survey; GNSS/GPS; Photogrammetry; Positioning; Sensor fusion; Computer vision; Imaging

SUMMARY

Mapping with unmanned aerial vehicles (UAV) and autonomous driving are megatrends that bring new challenges and opportunities also for surveying applications. In the last years, dramatic advances in computer vision and artificial intelligence have opened up new perspectives in positioning and reality capture systems. These applications rely upon an accurate and robust determination of the absolute six degrees of freedom (6DoF), mainly combining global navigation satellite system (GNSS) and inertial navigation system (INS). Including GNSS has the main advantage of accurate 3D positioning directly in a global reference system. Additionally, the integration of other measurement systems such as camera-based visual inertial systems (VIS), LiDAR, and scanning will benefit from the precise attitude information and globally referenced positions.

This paper aims at analyzing the potential and performance of combining simultaneous image capturing and absolute 6DoF information for surveying applications. The 3D position and attitude estimation by means of a GNSS/INS system is consolidated with a camera and computer vision algorithms. This image-based surveying approach enables accurate remote point measurements by fusing GNSS RTK with terrestrial photogrammetry directly in the field, providing globally referenced positions with centimeter-level accuracy. Photogrammetric surveying and scene documentation can be performed conveniently in a global reference system. Additionally, high-precision survey-grade measurements becomes possible in GNSS degraded and denied locations enhancing productivity and user experience.

In this study, global position and attitude information are combined with computer vision algorithms and camera captures to measure points in images. The results are compared against a reference field with a higher order of accuracy. Representative tests were carried out by considering

various camera-to-object distances and trajectories varying in length and geometry to evaluate the accuracy and reliability of this novel sensor fusion platform. The outcomes show that the combination of photogrammetry with a GNSS/INS system offers enormous potential in land-based surveying applications where globally referenced measurements are demanded within the shortest time.