LIDAR Data for Photogrammetric Georeferencing

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SUMMARY

In a swiftly changing world, there is a growing demand for accurate information pertaining to physical surfaces for a variety of applications (e.g., automatic DEM generation, city modeling, and object recognition). For these purposes, 3D spatial data can be gathered from a number of diverse sources. In this regard, LIDAR and photogrammetric systems are receiving major attention due to their complementary characteristics and potential. An appealing feature of LIDAR is the direct acquisition of numerical 3D coordinates of object space points. The discrete and positional nature of LIDAR sets makes it difficult to derive surface semantic information, e.g., surface discontinuities and types of observed structures. In addition to that, reconstructed surfaces from LIDAR data possess no inherent redundancy. In aerial laser systems, LIDAR points are usually computed in the GPS reference frame, WGS84 for example, and consequently, it makes sense to reference the aerial images to the same system. In contrast to LIDAR systems, reconstructed surfaces from photogrammetric measurements possess rich semantic information that can be easily identified in the captured imagery. Moreover, reconstructed surfaces tend to be very accurate due to the inherent redundancy associated with photogrammetric intersection. The drawback of photogrammetric surface reconstruction is the significant time consumed by the process of manually identifying conjugate points in overlapping images (matching problem). On the other hand, automating the matching problem remains an unreliable task especially when dealing with large scale imagery over urban areas. Still, photogrammetric reconstruction of real surface requires enough control in the form of control points or other control features.

The complementary characteristics of both systems can be fully utilized only after successful registration of the photogrammetric and LIDAR data relative to a common reference frame. The registration methodology has to tackle the basic registration procedure components, mainly: registration features, mathematical function, and similarity assessment. This paper presents an approach for utilizing straight-line features derived from both datasets as the registration primitives. LIDAR lines are directly incorporated as control information in the photogrammetric triangulation. In addition to the registration approach, this paper displays two approaches for extracting linear features from LIDAR data with different and without post-processing. Also, this paper supports a comparison between the performance of photogrammetric analog and amateur digital cameras and its impact on the registration process. The performance analysis is based on the quality of fit of the final alignment between the LIDAR and photogrammetric models.