A Global Photogrammetry-Based Structure from Motion Framework: Application in Oblique Aerial Images

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SUMMARY

In recent years, oblique aerial images have come back to the foreground, being involved in various photogrammetric applications. Moreover, multi-camera systems have become a well-established technology, providing oblique and vertical aerial images that depict both horizontal and vertical structures of the environment from several perspectives, leading to an increasing market availability of such kind of images. The main prerequisite for their metric exploitation is the knowledge of the camera exterior orientation parameters, which are usually determined through a Structure from Motion (SfM) process that estimates corresponding features between overlapping images and solves the multi-image aerial triangulation problem. This paper presents a complete photogrammetry-based framework that solves the SfM problem, which covers the topics of determining overlapping images, feature extraction, image matching, rejection of outliers, feature tracking and bundle block adjustment. The proposed framework adopts a global SfM workflow that relies on approximate camera exterior orientation parameters, which are almost always available through the data provided by onboard GPS/INS sensors. The proposed SfM methodology is applied in different configurations of oblique aerial images (same perspective oblique images, multi-view oblique images and combined nadir and oblique multi-view images) under a non-ideal aerial triangulation scenario characterized by lack of well-distributed ground control points as well as minimum manual image measurements and the results are outlined in the paper. The exterior orientation parameters computed through the proposed SfM algorithm have better accuracy than the ones achieved through a commercial SfM software package. Thus, the proposed global SfM framework proves to be a good alternative solution to existing SfM methods.