論文の内容の要旨

Thesis Summary

論文題目　An Automatic Digital Object Model reconstruction From Optical Flow Field based Dense Aerial Image Matching （オプティカルフロー場に基づく高密度空撮画像マッチングを利用したデジタルオブジェクトモデルの自動生成）

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（本文 Body）

In recent decades, 3D modeling has becoming more and more important in many real applications, such as urban planning, autonomous driving and evacuation planning. In order to build a more detailed 3D digital model. A digital object model generation workflow has been proposed in this thesis. For poor textural images, matching robustness is vulnerable to low contrast, repetitive patterns, occlusions and homogeneous textures. To address these problems, a novel feature matching algorithm is proposed in this paper which uses graph theory as a proxy: First, point features are extracted in both source and target image respectively to form feature set P and Q, which constructed graph GP, GQ subsequently. Then, an edge weighted strategy is adopted to build affinity tensor between GP and GQ. At last, the node correspondences between GP and GQ are acquired by using high order graph matching algorithm, and the feature matching process is finally completed by this proxy. In order to demonstrate the feasibility of our algorithm, several experiments are conducted, in which typical poor textural images that contain forest, desert, farmland and urban are used. And the comparison studies and experimental results proved that our algorithm has significantly improved on matching recall, number of correct matches and positional accuracy. As it is known to us all, efficient and robust method for dense image matching has been one of the technical bottlenecks in the three-dimensional (3D) reconstruction of wide-range aerial images. In addition, it has attracted increasing attention in the field of Photogrammetry and Remote Sensing. In this paper, we proposes an

improved optical flow field based dense image matching (OFFDIM) algorithm for low altitude UAV (unmanned aerial vehicle) aerial images. A coarse-to-fine matching strategy is utilized for the pixel-wise correspondence searching across the stereo pairs. First, pyramid L-K method is adopted to generate the sparse optical flow fields within the stereo image pairs. Second, an adjusted control lattice is utilized to determine the multi-level B-spline interpolating function for the dense optical flow fields estimation. Third, both radiometric and geometric constraints are employed to refine the coarse dense point clouds. On this basis, the performance of the OFFDIM is analyzed in terms of four aspects: specifically the visual effects of the 3D point clouds, the matching success rate, the matching accuracy and the matching reliability. A large number of experiments are conducted on a set of low-altitude UAV images, in which the image size is 10,608×8,608 pixels, the ground sample distance (GSD) is 7 cm , and the forward overlap is 60%. Quantitative evaluation indicates that, OFFDIM generated correspondence accuracy could reach ±0.7 pixel in image coordinate and ±20 cm in ground elevation which is better than ±3 GSD, the matching success rate was higher than 97% and a single stereo pair operation time on CPU was about 272 second. The proposed method was compared with the-state-of-the-art PMVS and SGM algorithm, which are considered as the most effective dense matching methods for UAV images. The results have demonstrated that the proposed method delivers matches at higher completeness than PMVS and SGM, what is more, the matching efficiency improved more than 6 times, and the matching accuracy achieved the same level as SGM which indicates that the proposed method show increased applicability to the UAV image based dense matching and high-precision 3D geospatial information extraction. In order to improve the 3D point cloud identification accuracy, both image and DSM are used as input to a modified fully convolutional network. This method both concerned the 2D texture information and 3D spatial information. The experimental results demonstrated that our methods are outperforming the traditional methods. Compared with well-known deep learning methods, such as fully convolutional network and Residual network, our method get better results especially in ground identification. At last, the generated digital object model contains annotation information for each ground objects, compared with traditional digital surface model, it is more useful for some specific applications.