Hybrid Selection of Image Features in the Generation of Ground Control Frameworks for Remote Sensed Images

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The objective of this study is to establish a control framework database to support related remote sensing applications. Original aerial images, along with their orientation parameters derived from aerial triangulation calculations, are used to manually or automatically select suitable targets that are difficult to change or have sufficient contrast radiance, such as building corners, road marking and so on. During this process, the three-dimensional coordinate data and related information for the image center points are recorded. If such data processing is conducted for a large-scale aerial survey project, it results in what is known as an image control framework database.

In modern aerial photogrammetry, automated matching procedures are primarily used to collect observed measurements of image points, with manual reinforcement applied only in areas with poor network intensity. As a result, the number of tie points in modern aerial survey projects is substantial. However, the tie points generated by automated matching aren't necessarily all usable for the construction of a control framework database, as many of them are not suitable targets. Therefore, this study aims to design effective conditions for automated point selection, including factors such as image contraction range, image point type, multiple rays, theoretical accuracy, image gradient, and AI-based land classification.

With the recent improvements in the spatial resolution of satellite images, tie point selection procedures will also consider satellite image matching. By performing a regional adjustment on satellite images to obtain the object-image correspondence model (Rational Polynomial Coefficients, or RPCs), we can back-project the object space coordinates to extract the appropriate image area for aerial-satellite image similarity comparison. This approach ensures recognizability between different types of images derived from different sensors. Additionally, LiDAR terrain information is incorporated for elevation optimization.

Ultimately, the three-dimensional coordinate components achieved an external accuracy of within 50 cm, and the spatial coverage rate exceeded 95%. This research implements the production process of the control framework using programming languages and has been applied on a large scale in the Yunlin, Changhua, and Nantou areas of Taiwan. The results can be utilized for applications such as 1/5000 small-scale aerial photogrammetry mapping or orthorectification of remote sensing images. Furthermore, given their widespread distribution and quantity advantages, the lifespan and range of application scenarios for these processes should be extended and expanded.

Keywords: Aerial Photogrammetry, Remote Sensing, Control Framework, Data Adjustment, Image Processing, Artificial Intelligence