DEVELOPMENT OF AUTOMATIC PRECISION GEOMETRIC CORRECTION FOR CAS500-4

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ABSTRACT : The need for remote sensing technology is increasing for efficient management and monitoring of farmland and forests. Accordingly, the CAS500-4 satellite, capable of enabling continuous monitoring of forest resources, has been scheduled for launch in 2025. The CAS500-4 provides multispectral images in blue, green, red, red edge, near-infrared (NIR) bands at a spatial resolution of 5 m. In order to effectively supply and utilize the CAS500-4 satellite image, it is necessary to correct geometric distortions in the satellite image by establishing a precise sensor model.

In this study, a precision geometric correction technology was developed for the effective utilization of CAS500-4 satellites. Ground control points (GCPs) were automatically extracted from simulated images for CAS500-4, establishing a precise sensor model. Based on this established model, precision orthoimages were generated. The proposed method consists of initial sensor modeling, GCP chip search, image pyramid construction, area-based matching, outlier removal, and precision sensor modelling. Firstly, an initial sensor model is established based on the initial RPC data. Secondly, the search area for the GCP extraction is defined and the search is performed. Thirdly, the image pyramid composed of 8x, 4x, 2x, downscaled images, and original images is constructed. At each level, the process of GCP chip matching and precision sensor modeling is performed repeatedly. The Zero Mean Normalized Cross Correlation (ZNCC) is used to extract matching points from the downscaled images of the image pyramid, and the local-block census method is applied to the original image. Finally, the RANSAC algorithm is utilized to remove outlier points, and geometric correction is completed through the establishment of a precise sensor model. For the experiment, we used satellite images that were simulated similarly to the CAS500-4 satellite images. We also used a ground reference point chip with a spatial resolution of 1 m and a size of 625 x 625 pixels previously produced for CAS500-4. To verify the proposed method, the accuracy verification of the automatic extraction ground control point, sensor model verification, and precision orthoimage verification were performed. The proposed method showed results of a planar error of less than 0.5 pixels in the accuracy verification of automatic extraction of ground control points. The precision sensor modeling accuracy and checkpoint accuracy errors at the sub-pixel level were shown to be less than 0.5 pixels at the ground control point chip resolution level. As a result of precision orthoimage verification, the average accuracy was found to be less than 2~3m, and when overlaid with digital topographic maps, it showed consistent alignment with the boundaries of roads, buildings, and fields.

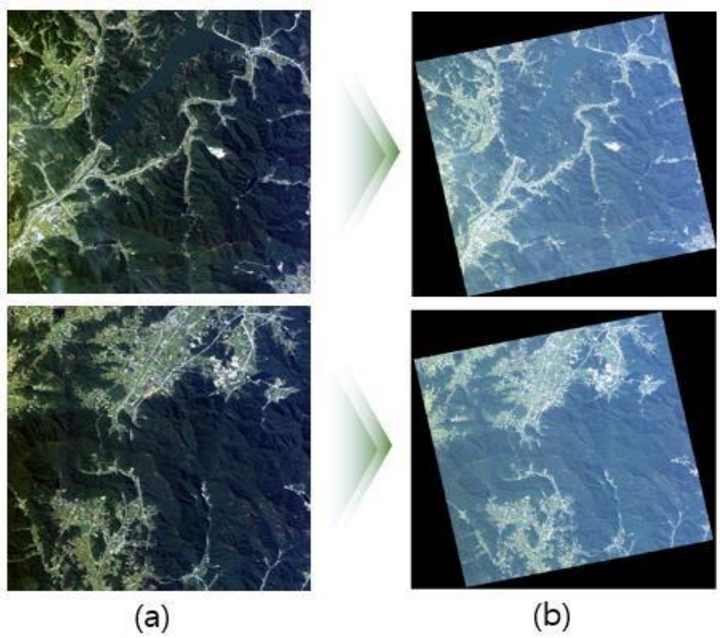

Figure 1. (a) Original images (b) precision orthoimage images generated by the proposed method

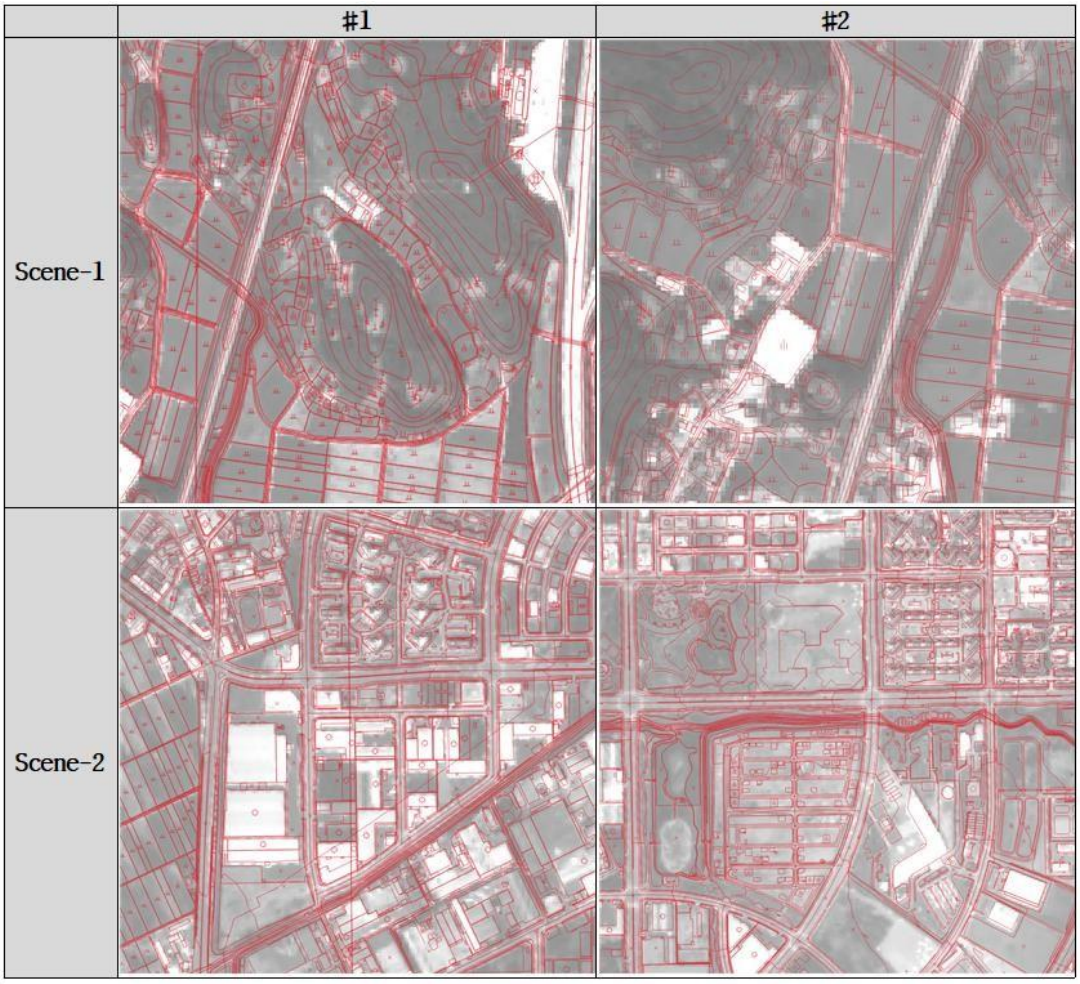

Figure 2. Precision orthoimage verification results

It is believed that the proposed method will allow CAS500-4 to establish accurate geometry and generate precise orthoimages with high positional accuracy. It is expected that it can be used in future research to develop precise geometric correction and orthorectification technology in overseas regions.

Keywords: CAS500-4, Geometric Correction, GCP Matching, Sensor Model

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