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Heterogeneous Feature Matching for the Orientation Modeling of Remotely Sensed Images

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Due to rapid developments of automatic processing, object positioning using remotely sensed images has become an important task in geoscience analyses and geoinformatic modeling. The reconstruction of image orientation is, thus, a must in most of the object positioning missions. Although many remote sensing sensors are equipped with Global Navigation Satellite System receivers and Inertial Measurement Unit for direct georeferencing, the accuracy is still to be improved for precision positioning. Thus, the ground control is needed in such geometrical processing for remotely sensed images. As compared to point control, linear features, such as road edges and building boundaries, include more topological information for automatic identification. This information acquired from a three dimensional database of geographical information systems(GIS) may yield higher reliability in search of matching conjugates . Aiming at line control for image orientation modeling, the objective of this investigation is to develop a matching method for corresponding heterogeneous linear features from a vector GIS database and their raster counterparts in the image space.

The first step of the proposed method is to develop line-based collinearity condition equations by the parameterization of straight lines. After the extraction of feature lines in a target image, the proposed coarse-to-fine method performs two stages of matching for quadrangles and line segments, successively. Coarse matching employs quadrangle control to modify the initial orientation parameters produced by the direct georeferencing. All candidate quadrangles as formed by possible combinations of feature lines in the area of interest are subjected to hypothesis testing by the examination of line-based collinearity condition. Then, the fine matching procedure searches for conjugate vector lines through the orientation computation by selecting the best fit for the collinearity condition.

The proposed method was validated using unmanned aviation vehicle images and Taiwan GIS database. Experimental results indicate that the proposed method can achieve accuracy close to the reference database.