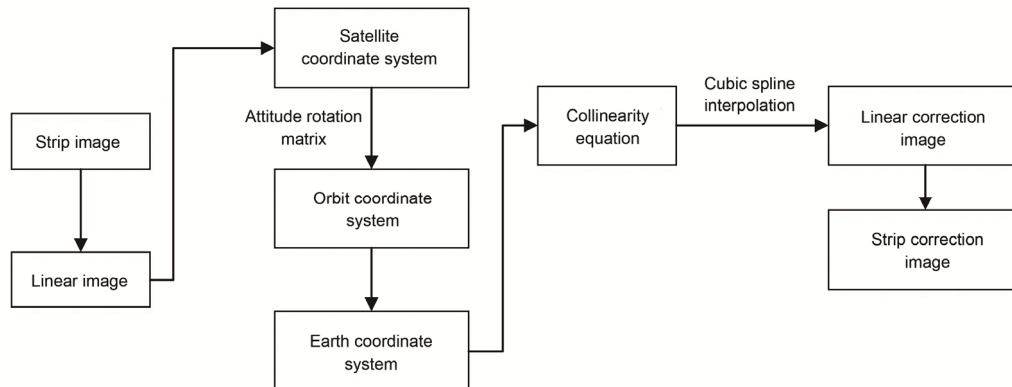


Analysis on stitching overlap pixel threshold of one-orbit multi-strip agile remote sensing imaging

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Flowchart of image correction of geometric deformation.

Abstract: This paper shows some simulation analysis on stitching overlap threshold of strip images for multi-strip stitching model in agile remote sensing imaging. To realize the high spatial resolution and high time resolution at the same time, agile satellites have been used more frequently. Besides the maneuverability of satellite attitude adjustment, the mission planning is the key to the efficiency of high resolution optical imaging. Thus, our purpose is to find the suitable stitching overlap width between two adjacent strips. Lower threshold will sacrifice the stitching quality of remote sensing image, while higher threshold will cause an inefficient imaging mission. The mission model and geometric degradation model are proposed for multi-strip stitching imaging, and the criterion of overlap region width threshold is presented. We use scale-invariant feature transform (SIFT) detector for image registration and random sample consensus (RANSAC) to eliminate the outliers. Besides the root-mean-square error (RMSE) of feature points in overlap region, the RMSE of four corner points and all pixel points of overlap region are considered. When all these three RMSE are less than 1 pixel, the overlap threshold is confirmed.

Against the nadir strip, we analyze the overlap threshold of different scene types and explore the threshold variation affected by the changes of ground sample distance (GSD). For the agile strip, the effect of pitch angle and roll angle on overlap threshold is analyzed. The simulation result shows that, at 0.46-meter GSD value, the overlap threshold is more than 28 pixels for 6 scene types, and it is even beyond 31 pixels for the airport and island. The statistical characteristics of threshold perfect match the 3σ guidelines in normal distribution, which has proved the reliability of the solution of overlap threshold. In nadir imaging, GSD has little effect on the overlap pixel threshold at image plane, but has a great effect on overlap distance threshold at ground plane. In agile strip, with larger pitch angle and roll angle, the overlap threshold will increase significantly, which means that the geometric degradation is more powerful to the threshold than the GSD variation. Compared with the roll angle, the pitch angle will bring greater impact on pixel threshold of overlap region. Specifically, when the equivalent pitch angle is beyond 40 degree, the pixel threshold grows significantly.

By analyzing the stitching overlap threshold of the strips in a variety of scene types and different remote sensing conditions in orbit, we give a meaningful suggestion to the mission planning of high resolution remote sensing imaging by agile satellite.

Keywords: agile satellite; multi-strip stitching; agile imaging; overlap region width threshold; scene type; ground sample distance; satellite attitude

Citation: Xu Yue, Feng Huajun, Xu Zhihai, *et al.* Analysis on stitching overlap pixel threshold of one-orbit multi-strip agile remote sensing imaging[J]. *Opto-Electronic Engineering*, 2017, 44(11): 1066–1074.

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