SAR MAPPING TECHNOLOGY AND ITS APPLICATION IN DIFFICULT TERRAIN AREA

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1. INTRODUCTION

SAR (Synthetic Aperture Radar) technology provides a new effective way on mapping where qualified optical image is difficult to obtain. In western China, State Bureau of Surveying and Mapping of China is conducting the Western China Mapping Project, which aims to generate 1:50,000 scale topographic and other thematic maps. In Hengduan mountain area, large area is perennially covered by cloud, fog, ice and snow. SAR mapping technology has to be used in this area. Nonetheless, the complex geographic environment still gives a challenge to mapping with SAR. The lush vegetation of this area makes InSAR technology difficult to create precise DEM. Stereo Radargrammetry becomes an effective method in extracting DEM in this area [1][2][3]. But the steep terrain with more than 3000m height variation, brings shadow and layover artifacts which cause many difficulties in Stereo Radargrammetry, such as mismatching, lack of information, etc. So, parallax editing function under stereo environment is developed to correct matching error and improve matching accuracy; DEMs created by ascending and descending SAR image pairs are combined by fusion based on rules to solve the problem caused by shadow and layover; ideal stereoscopic image pairs are created from both ascending and descending SAR image pairs to extract topographic features and solve the problem of lack of information in shadow and layover area. Experiments with high resolution SAR images in Hengduan mountain area prove that the scheme is feasible.

2. METHODOLOGY

The technical flow of Stereo Radargrammetry is shown in Fig.1. Parallax edition in image match and DEM fusion are used to solve the problem caused by the complex mapping environment. The technical flow of extraction of topographic features is shown in Fig.2. The method of generation of ideal stereoscopic image pair is proposed for topographic features' extraction.

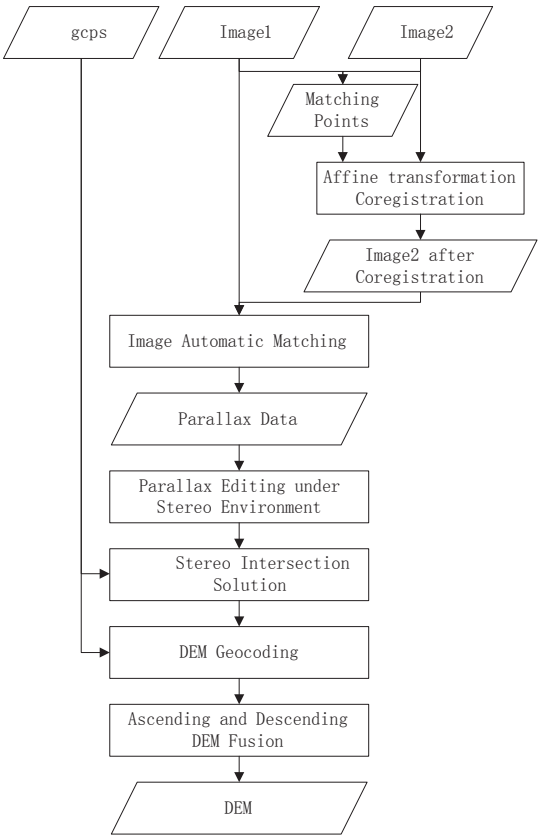

Fig1. DEM generation by StereoSAR

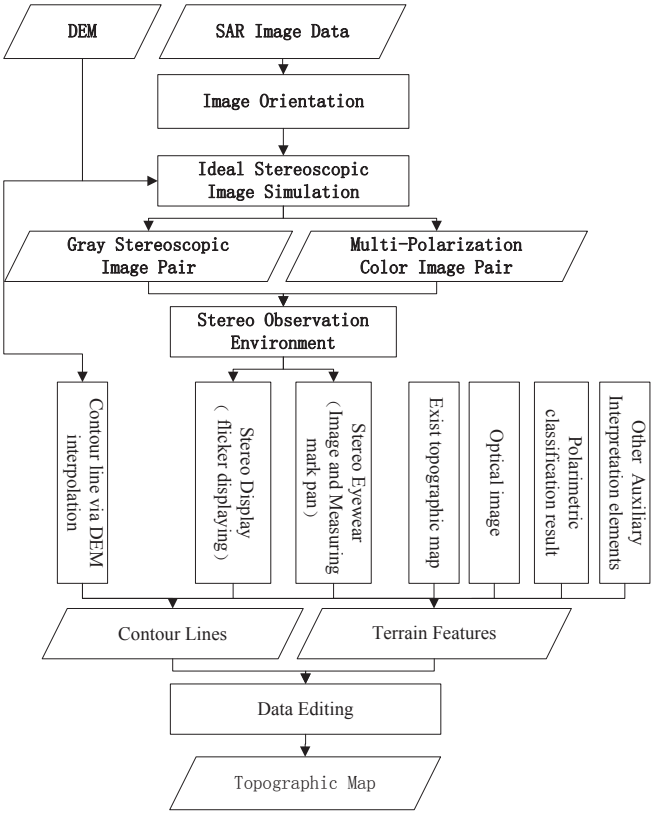

Fig2. Topogrphic features extraction

3. KEY POINTS ON SAR MAPPING IN DIFFICULT TERRAIN AREA

3.1 SAR image matching assisted by parallax edition in Zero Stereo model

Parallax editing under stereo environment is used to improve the quality of image matching. In a stereo SAR image pair, one image is reference image and another is matched image. After being rectified with the parallax data, the result of image matching, the matched image and the reference image make of a Zero Stereo model. When matching is correct everywhere, the terrain should be flat within the Zero Stereo model. But it is undulate when matching errors exist. So parallax editing can be easily carried out to correct the matching errors in stereo observation.

3.2 Fusion of DEMs from ascending and descending pairs

Lack of information in shadow and layover areas is solved with ascending and descending DEM fusion. Based on the terrain slope and aspect angles, a mask image can be generated which marks the areas affected by shadow and layover. Since the radar illumination rays of ascending and descending images are opposite to each other, the

masks will be complement to each other. Therefore DEMs extracted from the ascending and descending image pairs can be fused by setting a decision rule to exclude pixels in layover/shadow region.

3.3 Extraction of topographic features from ideal stereoscopic image pair

The key technique of extraction of topographic features in stereo environment is the generation of ideal stereoscopic image pair, of which the vertical parallax must be eliminated, and the horizontal parallax should be reserved [4][5]. The two images of the pair can be re-sampled from single SAR image, and can also resampled be from two different SAR images with overlapping regions. The pair generated from single image is called mono-source pair, and that from two different images is called dual-source pair. The stereoscopic pair image creation depends on DEM. In this way, the vertical parallax will be eliminated, and the horizontal parallax will be reconstructed. Stereo mapping with SAR stereoscopic image pair is feasible for extraction of topographic features (roads, buildings, etc.).

4. EXPERIMENTS AND CONCLUSION

In the experiment, TerraSAR ascending and descending stereo pairs are acquired. For ascending pair, imaging incidence angles are 29.09° and 46.06° . For descending pair, imaging incidence angles are 29 ° and 46.23 ° .

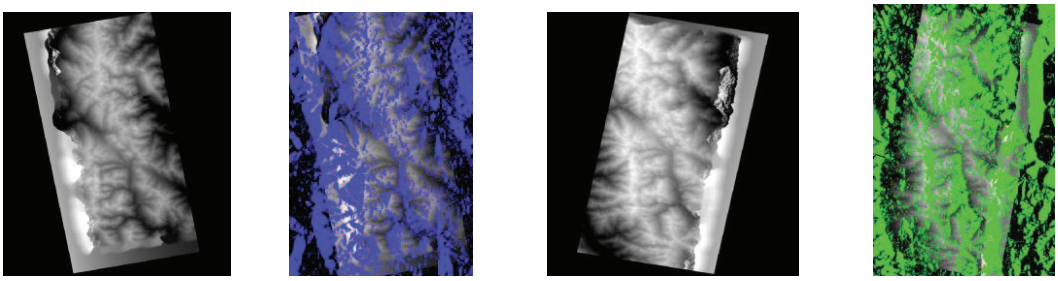

Fig3. Ascending and descending DEM creation and shadow, layover area detection

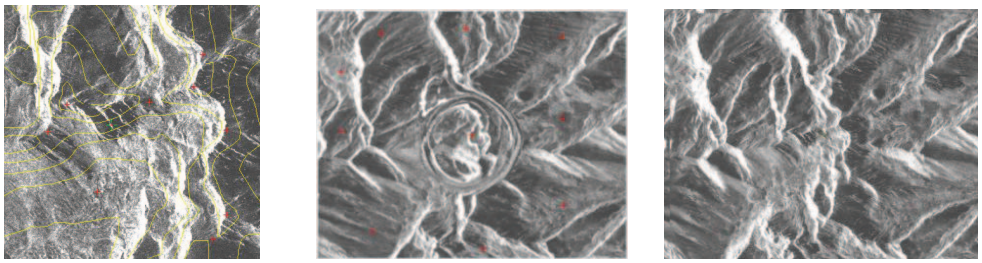

Fig4. Parallax isoline and feature point collection, error area collection and corrected result

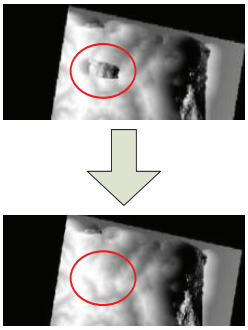

Fig5. DEM corrected by parallax edit

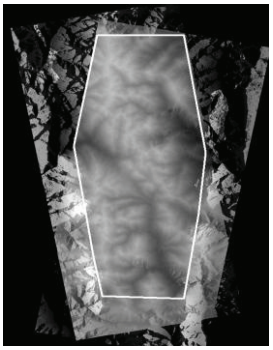

Fig6. Result DEM of fusion

Fig7. Contour lines

With the ascending stereo pair, mono-source and dual-source stereoscopic pairs are generated. Contour lines (Fig.8) of some parts in this region were mapped with the dual-model image pair.

In Hengduan mountain area, ascending and descending stereo pairs are used due to geometric distortions. Shadow, layover area are detected for ascending and descending DEM fusion. Error area of DEM are found out, and corrected with parallax editing. Finally, result DEM can meet the precision requirement with the scale of 1:50,000 in difficult area. Mono-source and dual-source image pairs were generated in the experiment with high resolution SAR images. Well stereoscopic vision and well elimination of vertical parallax were achieved. The contour lines mapping with the image pairs can meet the needs of producing topographic maps. Experiment demonstrated that the method proposed is feasible.

5. REFERENCES

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