JAGGY BOUNDARY ELIMINATION OF MULTI SPECTRAL IMAGE AT AIRPLANE BY USING QUANTILE

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ABSTRACT: We have developed some algorithms for airplane detection from high resolution satellite image. High resolution satellite image has two kind of images. One is panchromatic image. The other is multi spectral image. Multi spectral image has color information. But, ground resolution of multi spectral image is less than that of panchromatic image. Color images showed some jitters in boundary area of airplane. These jitters came from low resolution of multi spectral image. In this study, we proposed an algorithm to eliminate jaggy boundary of airplane by using quantile.

1. INTRODUCTION

Some methods[1],[2],[3],[4],[5] for detecting objects from high resolution satellite images have been proposed. High resolution satellite image has two mode, multi spectrum mode and panchromatic mode. Multi spectrum mode has optical spectral information. Panchromatic mode has advantage of high ground resolution compare with that of multi spectrum mode. Color image showed some jitters in boundary area of airplane. These jitters came from low resolution of multi spectral image. In this study, we proposed an algorithm to eliminate jaggy boundary of airplane by using quantile. Multi spectral image should be interpolated to fit with panchromatic image. There are three methods for interpolating the multi spectral image. These three methods are nearest neighbor method, bi-linear method and cubic convolution method. We tried these methods for evaluating the interpolation. Boundary lines were extracted from some objects. Airplanes were detected by using geometric features of the objects. Boundary lines of the objects are very important for airplane detection.

2. AIRPLANE DETECTION ALGORITHM

In this section, the sequential methods of airplane detection used in this study are described.

2.1 Satellite image used in this study

The object image is shown in Figure 1. This image was obtained on 2 May 2002. This area is included in Haneda airport that is located at the south west of Tokyo in Japan. Multi spectral image in Quickbird image has 4 band images that are composed of 3 visible band images and one infrared band image. The ground resolution is 2.44m. Panchromatic image in Quickbird image has 0.61m ground resolution. Quantization level of original image is 11 bits. In this study, we quantized from 11 bits to 8 bits.

Figure 1. Panchromatic image of target area

2.2 Preprocessing

Ground resolution of multi spectral image is less than that of panchromatic image. We improve ground resolution of multi spectral image by interpolation. Ground resolution of panchromatic image is 4 times

higher than that of multi spectral image. One pixel of multi spectral image corresponds to 16 (=4x4) pixels of panchromatic image. Difference of ground resolution is too large. Therefore, we increased the ground resolution of multi spectral image to 4 times. Size of multi spectral image enlarged to 4 times for both horizontal and vertical direction. At this process, there are three methods, nearest neighbor, bi-liner and cubic convolution. Bi-linear method showed the worst result among these three method. Enlarged image interpolated by bi-linear method became blur. Enlarged image by using nearest neighbor method, bi-linear method and cubic convolution are shown in Figure 2, Figure 3 and Figure 4 respectively. Figure 2 shows jitter on boundary of airplane. Enlarged image by bi-linear method shows blur. Enlarged image by using cubic convolution shows blur and smooth boundary of airplane.

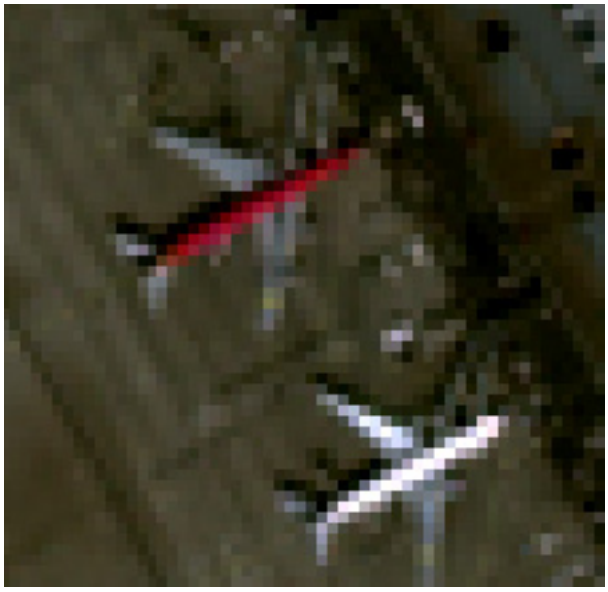

Figure 2. Enlarged image by using nearest neighbor method

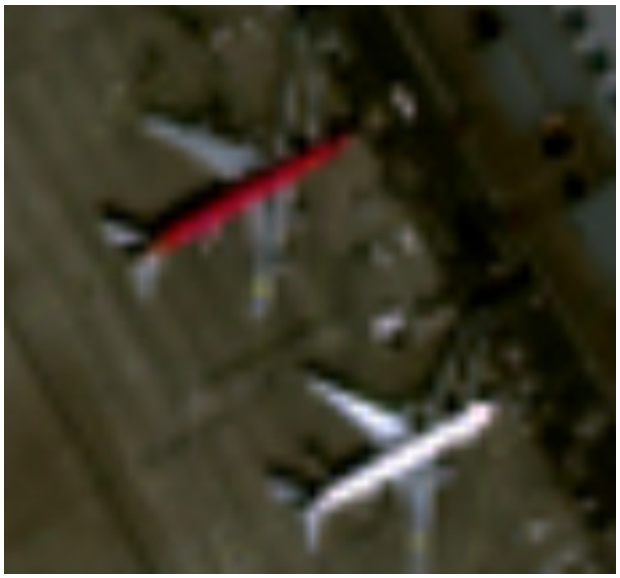

Figure 3. Enlarged image by using bi-linear method

Figure 4. Enlarged image by using cubic convolution method

2.3 Jaggy line elimination by using quantile

Figure 5 is panchromatic image of airplane. By comparing with Figure 2 and Figure 5, we can find out the jaggy line of airplane. Jaggy line elimination method by using quantile is proposed in this paper in order to preserve the clearness of image. Median is correspond to 1/2 quantile. We use median as the representative value of quantile. Figure 6 shows the filtered image of median filter.

Figure 5. Panchromatic image of airplane

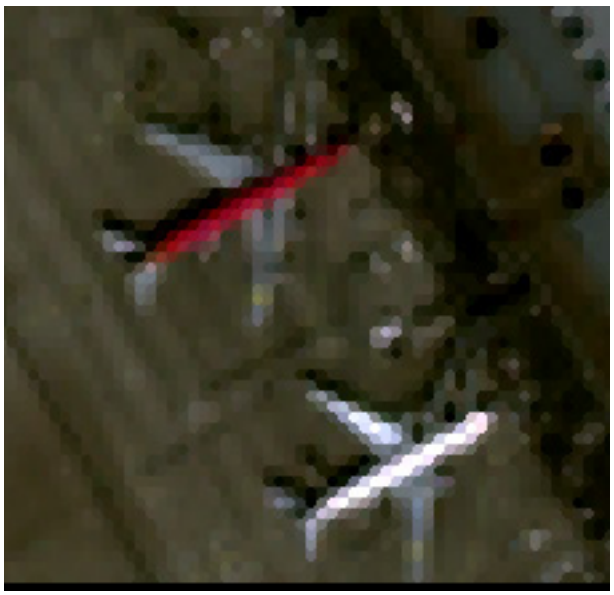

Figure 6. Median filtering image of enlarged image by using nearest neighbor

Figure 6 shows discontinuity of airplane. We tried median filtering again. The obtain result is shown in Figure 7.

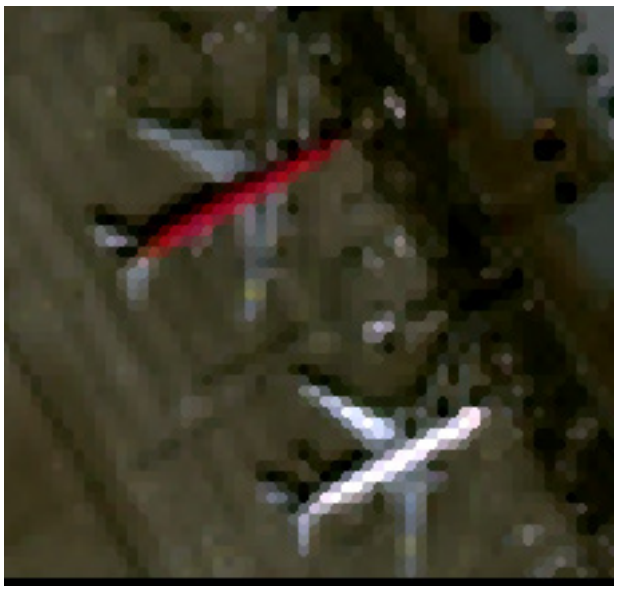

Figure 7. Median filtering image (twice) of enlarged image by using nearest neighbor

Figure 6 and Figure 7 are almost same. We must consider other method.

2.4 Image enlargement by using pyramid structure

Four times enlargement of target color image was applied. Same result can be obtained repeating the two times enlargement twice. Two times enlargement image is shown in Figure 8. After applying the two times enlargement, median filtering was conducted. Obtained result is shown in Figure 9.

Figure 8. Two times enlarged image by using nearest neighbor method

Figure 9. Median filtering image for two times enlarged image by using nearest neighbor method

Two times enlargement was applied for the median filtering image obtained above method. Figure 10 shows the result. Median filtering image for Figure 10 is shown in Figure 11.

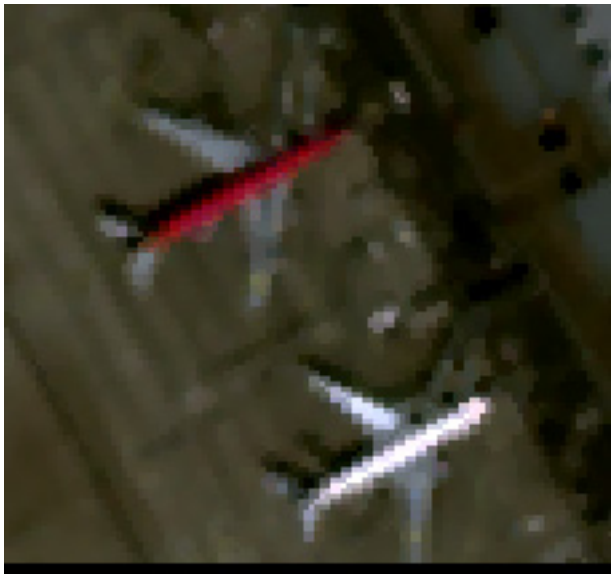

Figure 10. Two times enlarged image by using nearest neighbor method for Figure 9 image.

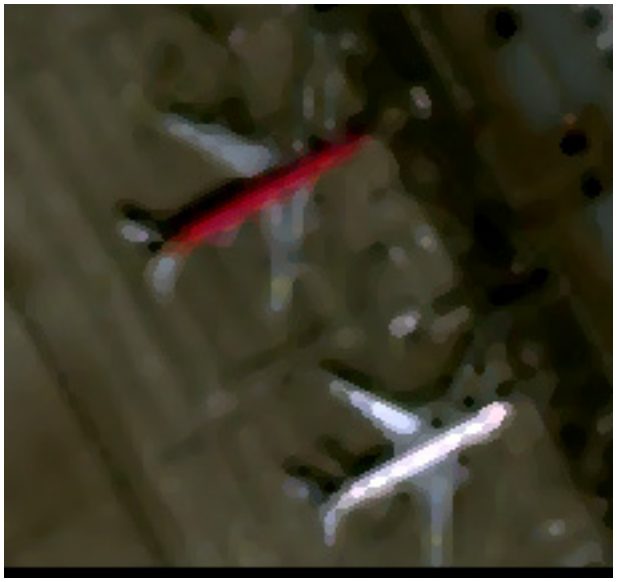

Figure 11. Median filtering image for two times enlarged image by using nearest neighbor method

By comparing with Figure 7 and Figure 11, we can find out effectiveness of jaggy line elimination in both methods.

3. CONCLUSION

New method was proposed for detection of airplane. In this study, we introduced the smoothing technique for interpolation of multi spectral image in order to eliminate jaggy line by using quantile. We could show the effectiveness of this method.

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