THE TIME DELAY BETWEEN PANCHROMATIC AND MULTISPECTRAL BANDS OF QUICKBIRD SENSORS

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1. INTRODUCTION

Recent years, several researchers have demonstrated the feasibility to use high resolution satellite images to detect the moving information of objects[4][5] . While the time delay between multispectral and panchromatic bands of the QuickBird (or Ikonos) sensors was not fully studied. They just used a rough figure or constant, such as 0.2 second to calculate the speed of moving objects. In order to get a more precise time delay, it is required to further study the reason and the principle of the time delay for pan and multi bands of high resolution satellite sensors.

2. THE REASON FOR TIME DELAY

Nearly all high resolution optical remote sensing satellites use push-broom scanning sensors. The CCD linear array sensors of different bands have different displacements in the focal plane. For example, the displacement between the panchromatic and multispectral bands of Quickbird is about 17.5mm. It is this displacement which makes the imaging time delay between panchromatic and multispectral bands for the same ground point.

3. TIME DELAY CALCULATION

According to the imaging principle of the line array CCD, for i^{th} line of the image, the imaging instant is [1][2]:

$$t_i = t_0 + (i-1)/LR \quad (1)$$

Here t_0 is the starting instant for imaging the first line, LR is the line rate of the camera.

So, the imaging instant for the m^{th} line of PAN:

$$t_m = t_{0p} + (m-1)/LR_p \quad (2)$$

Here, t_{0p} is the starting instant for imaging the first line of Pan band. L_{Rp} is the line rate of Pan band.

Just the same, the imaging instant for the n^{th} line of MS band can be expressed as :

$$t_n = t_{0m} + (n-1)/LR_m \quad (3)$$

Where, t_{0p} is the starting instant for imaging the first line of Pan band. L_{Rm} is the line rate of MS bands.

So the time difference between m^{th} line of Pan band and the n^{th} line of MS band is:

$$t_n - t_m = t_{0m} - t_{0p} + (n-1)/LR_m - (m-1)/LR_p \quad (4)$$

It should be noticed that all above equations are only true for the basic level image. As the standard or higher level products are resampled, the time tag for each line of the image is changed, and the resampling process does not remember the time tag for each line of the image.

For standard level image products, there is also a geometric model for time delay calculation.

4. SOME EXAMPLES

We chose one basic level and one standard level Quickbird image for calculating the time delay for moving vehicle, and compared the results with the original estimated time delay.

5. REFERENCES

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