

WHAT FACTORS AFFECT DATA QUALITY ACQUIRED BY ATH9010 UAV HYPERSPECTRAL IMAGER?

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1. Preface

Hyperspectral remote sensing imager features high spectral resolution, narrow range and spectrum combined images, so as to distinguish even tiny differences on earth materials and solve undetectable headaches by those wide range remote sensing. Thence the hyperspectral remote sensing (HRS) plays a great advantage on application in economy, atmosphere and ocean industry. Hyperspectral remote sensing imager has developed more and more faster and maturer, it has been effective to obtain earth materials data and accurate positioning to know target materials size and plants health status etc. Please refer to the ATH9010 field fly pictures in pig1.



FIG 1 ATH9010 UAV HYPERSPECTRAL IMAGER FIELD FLYING

The first thing to obtain high-quality data of the target area can be essential for successful research by UAV hyperspectral imager. However, the target area map and surrounding area, air condition and data acquisition setup can influence the data quality. How to improve the raw data quality acquired becomes very important, then this articles starts analysis these factors and solutions to reduce bad influence as a

result.

Different raw data qualities can be divided into four types to make analysis, take acquired data by ATH9010 for instances:

2. Images Quality

Images quality depends on two factors, one is camera resolution, the other is focal length setting. Since camera resolution is designed by the manufacturer, how to set focal length can avoid de-focus images, it's necessary to preset a focal length reference standard or adjustable range in order to minimize image clearness influenced by flying height. The right screenshot shows better image clearness after setting good focal length.

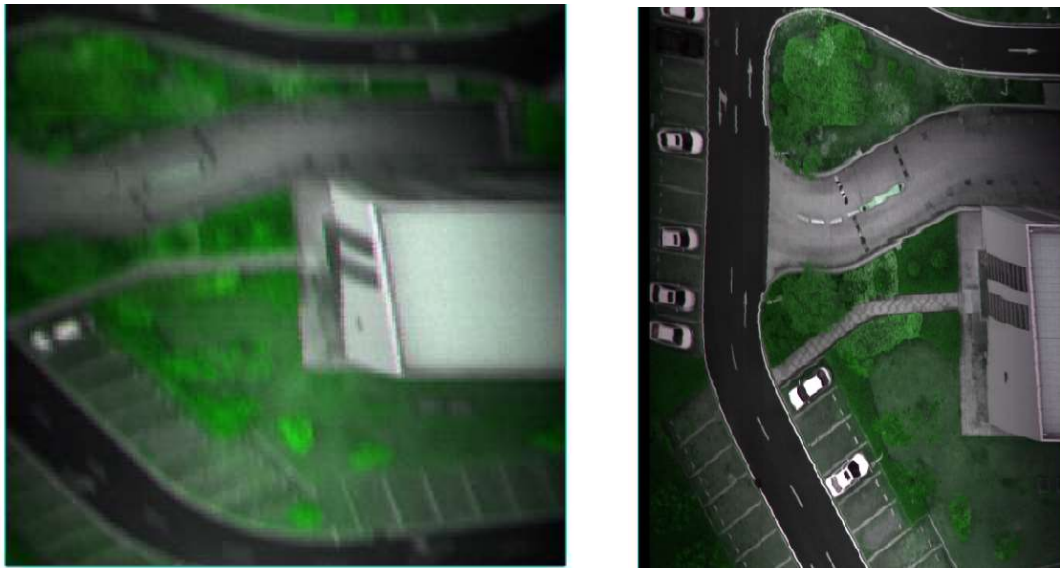
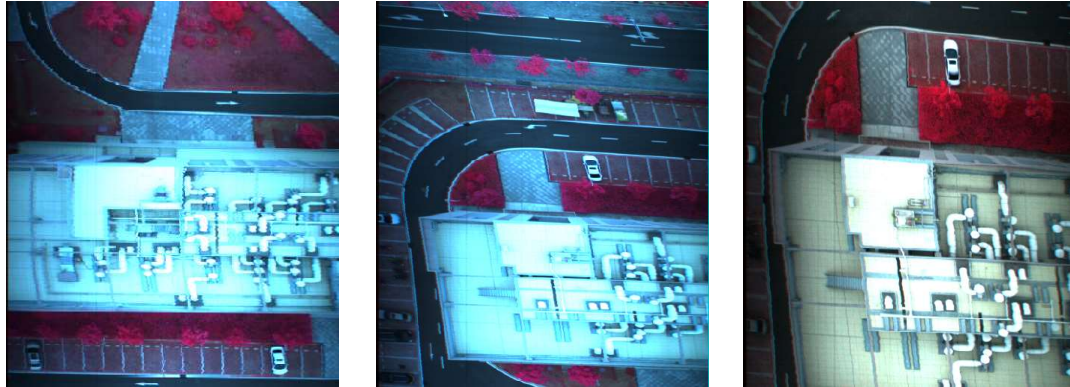


FIG 2 RESET FOCAL LENGTH TURN BLUR IMAGES TO CLEAR IMAGES

3. Longitudinal deformation of image

It's found that images elongation or shortening problems during flying test called keystone distortion. In vertical paralleled to UAV flying direction generates distortion for UAV fly speed have not been well matched with camera frame rate. In theory UAV fly speed is faster than camera frame rate, it has shortening images for losing frames while taking images. On the contrary, if the UAV fly speed is slower than camera frame rate, it has elongation images for taking more frames into images.

Please refer to normal image, shortening image, and elongation image in sequence below:



Normal Image

Shortening Image

Elongation Image

Fig 3 Keystone Distortion Images vs Normal Images

Individual pixel width can be calculated by formula with H_{UAV} (UAV height) , IFOV, V_{UAV} (travel speed), FPS (camera frame) formula refer to:

$$FPS = 0.8 * \frac{V_{UAV}}{2 * \tan(IFOV/2) * H_{UAV}}$$

It's usual to set FPS of 50-85 at a travel height of 100 m during fly test.

4. Transverse deformation of image

It's still horizontal distortion during fly test refer to Fig 3 road images with jagged shape. It's taken into consideration high sky with strong wind and wind speed during fly test.



Fig 3 Road image in horizontal distorted jagged shape

5. How Is Radiation Intensity Affect Images Quality

Solar radiation intensity differs from weather condition, even if the camera set the same intensity and integration time, it still exists over saturation or low intensity. Low intensity can reduce SNR and reliability, and the over saturation data is invalid can not used to calculate reflectance. It's necessary to consider weather condition to set suitable intensity and integration time to fit to travel test.

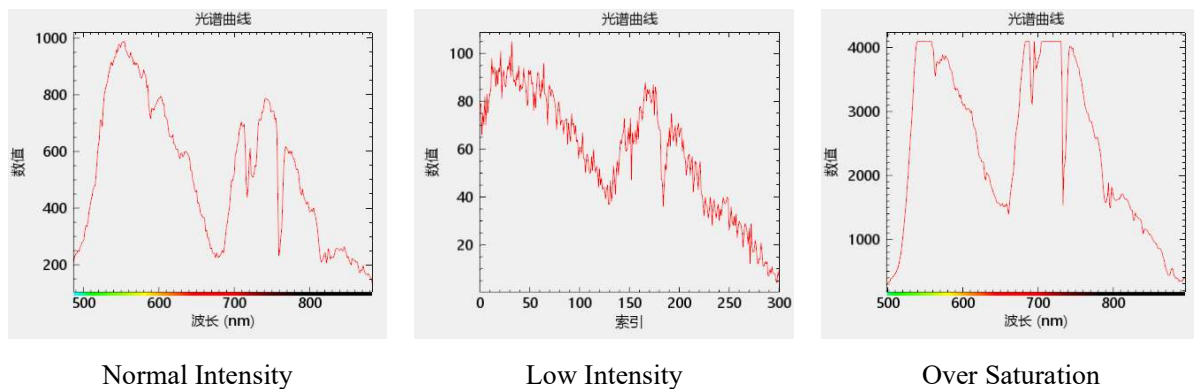


Fig 4 Plants Reflectance Spectrum in the Normal Intensity vs Abnormal Intensity

One solution can use standard white board to calibrate before travel test, if the white board at max. reflectance intensity is stronger than camera max. tolerance limit, it's considered to reduce integration time to set reflectance intensity at 60%-80% of saturation level. On the contrary, if the white board the max. reflectance intensity is less than 30%, increase the integration time till the reflectance intensity at 60%-80% of saturation level.

After running several fly experiments, set parameters as shown below can obtain better images quality refer to Fig 1

Fig 1 ATH9010 UAV Hyperspectral imager fly test set parameters:

| Items | UAV Parameters | Items | Imager Software Parameters |
|-------------------------|----------------|------------------|---|
| Height (H_{UAV}) | 100 m | Integration Time | 5 ms (cloudy, bright light) |
| Speed (V_{UAV}) | 6 m/s | Frame Rate | 50-100 FPS (relate to UAV height and speed) |
| Flight Distance (D) | 15 m | | |