APPLYING UNMANNED AIRSHIP TO RAPID DETECTION OF URBAN BUILDING CHANGES

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ABSTRACT:

In order to supervise and manage building change in urban development, unmanned airship is recommended for building change. With the unmanned airship, lower flying height can be obtained. As a result, high resolution aerial image can be acquired. And then, auto-aerial triangulation are easily applied to images so that product efficiency is greatly improved. And also, DSMs can also be quickly get. Width DSMs from different times in short period, building changes can be figured out by differential between DSMs.

1. INTRODUCTION

In the development course of urban, it is inevitable to face constructing new town and reforming old city region. Often, there are some buildings which appear illegally and block the normal process of city project. For example, the buildings constructed without license aimed at more compensation may appear at the reforming time. In order to supervise and manage these illegal buildings, especially for supervising constructing and tearing down buildings, the authorities need to know how things are going in the work area in every stage of the project. This means that the authorities need repeating survey the little region periodically, perhaps biweekly.

Building change doesn't means only construction of new buildings and tearing down old buildings, but also includes adding and removing floors from existing buildings. It is impossible to send a group of people to work around to record every height changes of city buildings by filling tables. Because nobody knows which building will be changed at next stage, then the conservative way and only way is to recording every building's state at each stage. It is a too burdensome work that it is unfeasible. As to DLG, it is not fit for recording Z data, say anything of that all building's data should be recorded in every survey. So DSM is preferred to be chosen. Then the building changes can be marked after computing difference of DSMs of different stages. If the DSM comes from photo, there are more detailed and intuitionistic information that can be shown.

In this paper, the reason why unmanned airship should be used in supervising building change will be depicted. Then things done in fieldwork and indoor work are specified. Especially, auto-aerial triangulation is paid more attention, for it is very important in fast aerial photogrammetry.

2. RECOMMENDED WORK PLATFORM

For litter region, ground survey can get detailed information and reach high accuracy and precision. But it is expensive, and most worse it is inefficient. It can not accomplish mapping and recording building changes in a few days. Conventional air photogrammetry is also not fit for litter area and short period repeating survey. As to remote sensing, there should be a special satellite focus on the little region statically for long time which is wasteful. In this case, unmanned aerial vehicle may be a good choice, for its simple mode of taking off and landing, relative safety, and ability of low fly height. And considering photographing on the urban, unmanned airship is preferred for its more security, which is also a kind unmanned air vehicle.

Unmanned airship doesn't need large area of even ground for taking off and landing. Hundreds of square meters' playground or grass lawn is enough, or even a section of straight road of one hundred meters is also OK. For the whole surveying region would be surveyed repeatedly, for example, once a week or twice a month, thus the airship does not need inflation and deflation at each survey, but just on inflation at first time and one deflation at last time. Unmanned airship can fly at a height of nearly 3 kilometers, but also can fly at a low height of a few dozen meters. For large scale surveying and mapping, the fly height is always restricted lower then one kilometer. Then you can see unmanned air ship can fly very low to get high precision images in accord with project demands, and sometimes, can participate in close range photogrammetry.

3. FIELDWORK

The sensor should be discussed in some extent at first. Generally, professional aerial photogrammetryic cameral should be used in aerial photogrammetry. At present, general digital cameral also can be applied to aerial photogrammetry if it is rectified in advance. By comparison, general digital cameral is cheaper, lighter, easier to access. It is much more fit for assembled in unmanned airship.

Unmanned aerial vehicle is usually unstable when fly in the windy condition. This cause the camera assembled in the unmanned airship to be unstable, that means that the principle axis of cameral would depart from perpendicularity to far and direct to orther direction arbitrarily. To avoid this, two-axis or three-axis stabilizator should be recommended. When taking photos in the air, the camera is assembled in stabilizator which should be designed to keep the cameral posture angle restricted within 5 degrees or so. The Figure 1 shows a picture of airship.

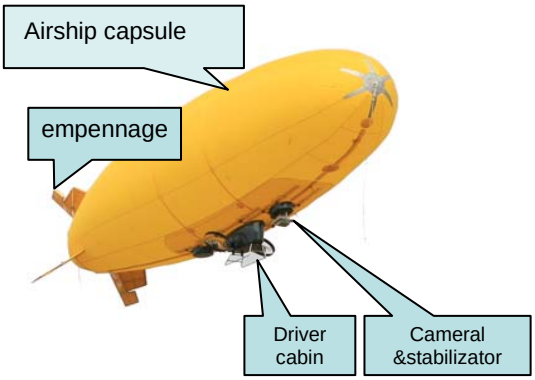


Figure 1. Picture of airship

In order to fly more smoothly and reposefully, unmanned airship should be controlled by pre-programmed automatic controller when it is flying in the air. And most important, for the sake of auto-aerial triangulation (AAT for short) which is the key to efficiency and real time process and also the key step to this thesis, it is commanded that photos taken from airship should have about 80% degrees of forward overlap and 60% degrees of side overlap. As figure 2(A,B) shows. In this case, there are enough corresponding points and tie points between adjacent photos and stereo models.

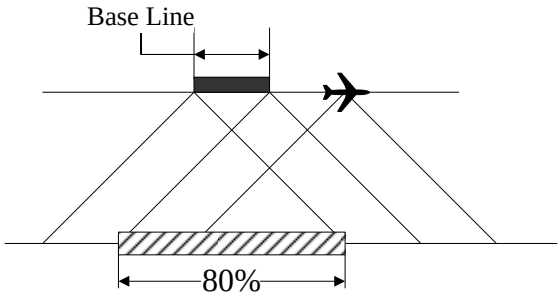


Figure2. A. Forward overlap

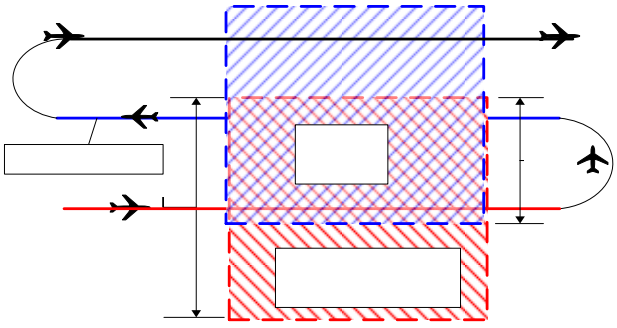


Figure2. B. Side overlap

There is something else we should pay attention to: Some building changes may not great. They may have height changes of one meter or 3 meters. So when design the flying height, the precision must be considered in advance.

4. INDOOR WORK

When flight is finished, with Airborne Image and POS data was recorded, it is time to get read for auto-aerial triangulation. First, check data: Is there any data lost? Is any error exits? Is the quality of the data meets the requirements? They all should be examined carefully. If everything is ready, or the error is filtered out or correct, then gather the data into project, start up AAT, leave the work to the computer. According to our own software MAP-AT, and hardware: windows XP system, 1G memory, 1.8G inter CPU, the processing shows that: about 120 stereo images can be proceeded in a hour with image size 3000 pixels multiply 4000 pixels.

Then, raw DSM can be produced though epipolar images and geometrically constrained feature point hierarchical Matching. Next, after process of relaxation matching, the final high precision DSM can be obtained.

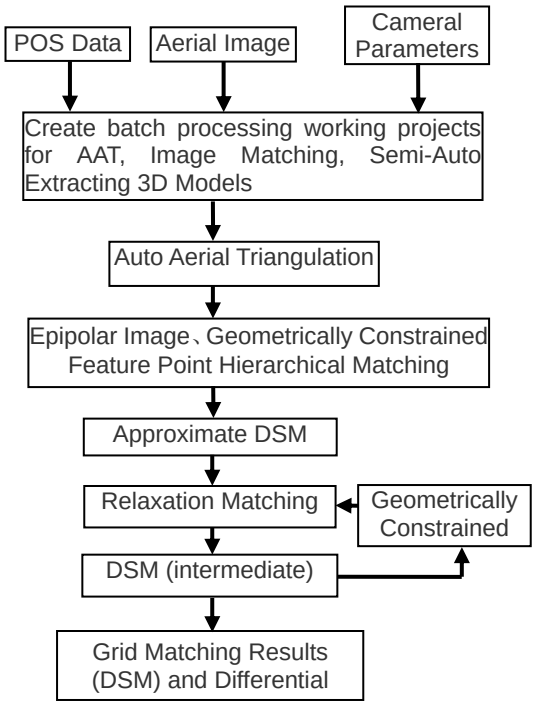


Figure 3. Work flow of building change detectionj

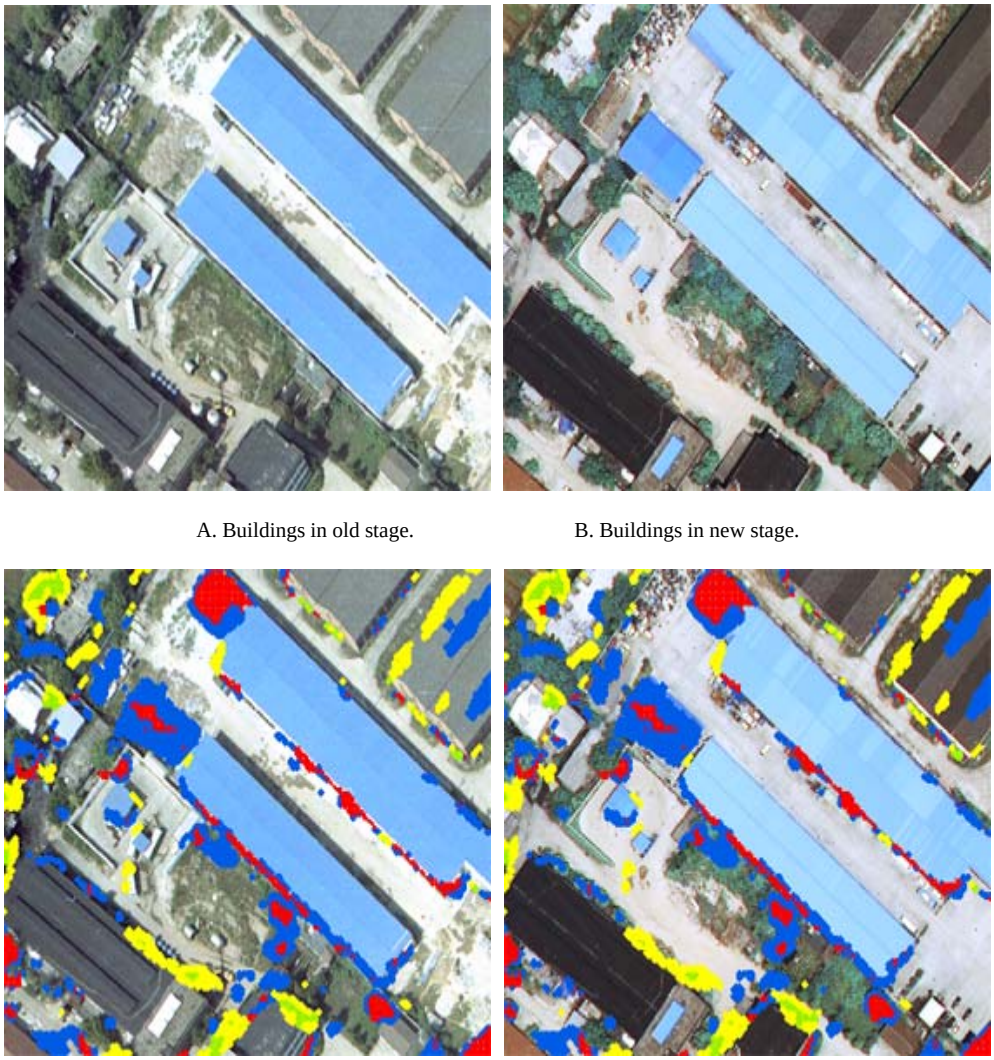
At last, what is left is to get building changes in different period, and what should be done is to get DSMs from different period and make comparison. For example, if you have DSM produced two weeks ago, and now you get another DSM today, subtract one from another, then building changes are marked with different colour, and different colour shows different height change: Green colour means new building with height change greater than 1 meter. Red colour means torn down building with height change greater than 1 meter. Blue colour means new building with height change greater then 5 meters, and so on. And the colour can be customized according to user's custom.

Then we get the work flow of field and indoor word (all of these constitute the flow of building change detection). The flow can be simply showed as figure 3.

5. EXPERIMENT

In our experiment, Height changes of greater then 3 meters are set to be detected. And the results of experiment on test city show that: what was proposed in advance is feasible and practical. All building height changes which are greater than 3 meters and less then 5 meters are detected. The hardware and

software needed in the experiment are easy to meet, and can fulfill the near-real-time requirements. The sample of the result is showed as Figure 4. The two stage apart for a long time, so the change is big.



A. Buildings in old stage. B. Buildings in new stage.

C. Detection overlay on old stage image. **D.** Detection overlay on new stage image

Red colour implies the building "grows " more then 5 meters; Green colour implies building "goes down" more then 5 meters; Blue colour implies building "grows" between 3 and 5 meters; Yellow colour implies building "goes down" between 3 and 5 meters.

Figure 4. Sample of detection experiment.

6. CONCLUSION

Through experiment, it is confirmed that city building change can detected by make use of DSMs of different period. And there are many excellences in aerial images for detection:

1) Easily recognize objects from images
2) Possible to correct POS errors through triangulation
3) High resolution and accuracy
4) to generate ortho-images and digital maps incidentally

There is also something not easy to copy with. Airship is easily be disturbed by wind, though we can produce big airship to resist strong winds. And even though stabilizator is used, there are many neighbour images can't get enough overlap when the

wind goes bigger than grade 4. Sometimes other electronic interference should be removed for making sure flying according to the prepared programmed track. Before auto-aerial triangulation, data checking is very important.

And there are something left to be following work. The most important is that: Some noise can not be correctly picked out, for example, mobiles, Trees, and so on. Perhaps, to recognize theses automatically is a long way to walk.

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