Transmission Tower Environment Monitoring Using UAV

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Abstract. Power utility engineers used to conduct ground survey to collect topographic data. Therefore, they can get detailed and accurate information, but these techniques take a lot of labors and expenses, and spending times for the surveying. An attractive solution to the ground survey is using images taken using Unmanned Aerial Vehicle (UAV). Images captured from UAV can be collected quickly and efficiently over the same area covered in the land survey, in a fraction of the time. The purpose of this research is to mosaic the large numbers of spectral images together into a region wide panoramic image which allows experts to analyze the data for transmission tower monitoring purposes.

1. Introduction

Power utility engineers take into account numerous factors when physically designing a new transmission line. There are several design options available to minimize costs and impacts on the communities and environment. Construction costs, repair time and environmental impact, among other factors, generally lead to placing transmission lines place above ground (known as “overhead”) rather than underground. There are many types of structures that can be used to support overhead power lines. These structures differ in cost, span length (the distance between structures) and in height and width. In the end, the structure design must fit within the available corridor, minimize environmental impacts and be cost effective for customers and utility.

Usually, field workers used to conduct land survey to collects topographic data for design purposes. Land surveying is conducted on the ground, so generally it is very close to observation targets. Therefore, they can get detailed and accurate information, but these techniques take a lot of labors and expenses, and spending times for the surveying. Also, it is not always safe in the case of the stricken or rural area.

Hence, to save cost and time, Unmanned Aerial Vehicle (UAV) is a promising approach in the process of collecting topographic data for area of interest. UAV is a flight is either controlled autonomously by computers in the vehicle, or under the remote control of a navigator, or pilot on the ground or in another vehicle. When an UAV is flying in certain height to perform a task of remote sensing, the serial images are shot by a digital camera mounted on UAV.

The purpose of this research is to mosaic the large numbers of spectral images together into a region wide panoramic image which allows experts to analyze the data.
2. Related Work

Nowadays, data from UAV technology can be used in mapping applications but it needs some modification from certain aspect in order to fulfill requirement of mapping. An UAV based monitoring system is developed to obtain the wide-area coverage and the high levels of detail and accuracy of ground surveying [1]. The accuracy and resolution of the image are equal to images that taken from the ground though the survey are conducted from the sky [2][3].

In [4], Jiayuan Lin, Heping Tao, Yangchun Wang and Zhou Huang claim that the UAV imagery has very high spatial resolution which can be adjusted by changing flight altitude. Not only that, they also proposed UAV as a great potential platform for mountain hazards survey with the advantages of region-scale coverage and moderate timeliness.

U. Niemather, S.Rothmund, M.R. James, J. Traveletti and M. Joswig proposed a low cost remote sensing approach based on UAV and digital compact camera to enables high-resolution acquisitions of landslides [5].

3. Field Work

In this study, the minimal flight time and associated travel route of a UAV is determined by using Google Earth and AirPhotoNavi software. AirPhotoNavi software is able to calculate image overlap calculation and flight path determination while Google Earth application could easily be able to determine the region of interest and displays the feasible flight path for UAV.

3.1. Overlap calculation. The optimum flight path condition will be executed by keying in the camera information and shooting condition. For camera information requirement, consider a NDC (Near Infrared Digital Camera) with a focal length 28 mm, vertical sensor size, Sensor Size (V) 14.9mm and horizontal sensor size, Sensor Size (H) of 22.3mm are being used. The most suitable condition for UAV to fly with a flight speed of 166km/h and altitude of 1005.8m is highlighted with a yellow in colour as shown in Figure 1.

![Overlap Calculation Tab](image1)

**Figure 1.** Overlap Calculation Tab
3.2. **Flight Path** Using AirPhotoNavi software, in Flight Line Making tab (Figure 2); the coordinates of the Baseline Start Point and Baseline End Point will be shown automatically once import button has been clicked and a feasible 3D (three dimensional) flight path will be executed in Google Earth (Figure 3) simultaneously.

![Figure 2. Flight Line Making tab](image1)

![Figure 3. Feasible Flight Path](image2)

4. **Result and Analysis**

All the sequences images taken from UAV have been mosaicked using EnsoMosaic software to create 2-D planimetric mapping covering the test area (Fig. 3). Every image taken has 60% overlapped region with a ground resolution 15.5cm and 1000 x 2752 pixels. The mosaicked image is free from any distortion and represents the whole simulation model.

![Figure 4. The mosaicked image](image3)
From Table 1, it can be concluded that the conventional method has longer duration of project planning, field work and image processing compared to the UAV method. Since less time is required in UAV method, it makes this approach to be more cost effective.

|               | Land Survey | UAV       |
|---------------|-------------|-----------|
| Project Planning | 1 month     | 1 month   |
| Field Work     | 1 month     | 1 day     |
| Image Processing | 1 month    | 2 weeks   |
| Labour         | 4-5 person  | 2 person  |

5. Conclusion and Future Work

This paper has proved that the UAV low altitude remote sensing system could provide the same result as ground survey with a low-cost, less-security risk and simple-operation. Based on the result obtained, it can be concluded that this approach can be used effectively for transmission tower environment monitoring since the images captured from UAV can be collected quickly and efficiently over the same area covered in the land survey, in a fraction of the time. Further work would focus on calculate and reduce cumulate errors and residuals errors of spectral images.

References

[1] A reference Masahiko Nagai, Apichon Witayangkurn, Kiyoshi Honda, and Ryosuke Shibasaki, “UAV-Based Sensor Web Monitoring System,” International Journal of Navigation and Observation, vol. 2012, Article ID 858792, 7 pages, 2012.

[2] Niethammer, U., James, M.R., Rothmund, S., Travelletti, J., Joswig, M. “UAV-based remote sensing of the Super-Sauze landslide: Evaluation and results” (2012) Engineering Geology, 128, pp. 2-11.

[3] Liu, C., Li, W., Lei, W., Liu, L., Wu, H. “Architecture planning and geo-disasters assessment mapping of landslide by using airborne LiDAR data and UAV images” (2011) Proceedings of SPIE - The International Society for Optical Engineering, 8286, art. no. 82861Q.

[4] Jiayuan Lin; Heping Tao; Yangchun Wang; Zhou Huang; , "Practical application of unmanned aerial vehicles for mountain hazards survey," Geoinformatics, 2010 18th International Conference on , vol., no., pp.1-5, 18-20 June 2010 More references

[5] U. Niethammer, M.R. James, S. Rothmund, J. Travelletti, M. Joswig, UAV-based remote sensing of the Super-Sauze landslide: Evaluation and results, Engineering Geology, Volume 128, 9 March 2012, Pages 2-11, ISSN 0013-7952, 10.1016/j.enggeo.2011.03.012.