GEOMORPHOLOGICAL CHANGE ANALYSIS OF BAZHANG RIVER CHANNEL WITH HISTORIC PHOTOGRAPHS

Peter Tian-Yuan Shih

Professor, Department of Civil Engineering, National Chiao Tung University, Taiwan.
Tel: + 886-3-5712121#54940; Fax: +886-3-5716257; E-mail: tyshih@mail.nctu.edu.tw

Abstract: Bazhang river is located in southern Taiwan featured with large terrain changes resulting from erosions and other causes. In order to understand the geomorphic change process, digital surface models (DSMs) of the major watershed are generated with historic photographs of different years, including 1991, 1999, and 2007. The comparison of DSMs from each year is conducted. It is found that the average terrain height is getting lower through years, and there are up to 3 meters scouring in the channel area. Further study is performed with topographic compartment analysis..

KEY WORDS: Photogrammetry, Aerial Triangulation, Terrain Analysis.

1. INTRODUCTION

"The future lies in the past", in order to learn what would happen with a river channel, historic aerial photos provided a convenient way for studying the geomorphological changes through years. The study site is Bazhang river basin. Rising from Alishan Fencihu in Chia-Yi, flowing through Chia-Yi and Tainan, the total length is 80.86km. The area of the basin is 474.74 km^2. Among this, 190 km^2 is in the high altitude range. The average slope of the channel is 1/42. Average annual rainfall volume is 1,082x10^6 m^3. Annual runoff is 745 x10^6 m^3. The geographical setting and focused study site is shown in Figure 1.

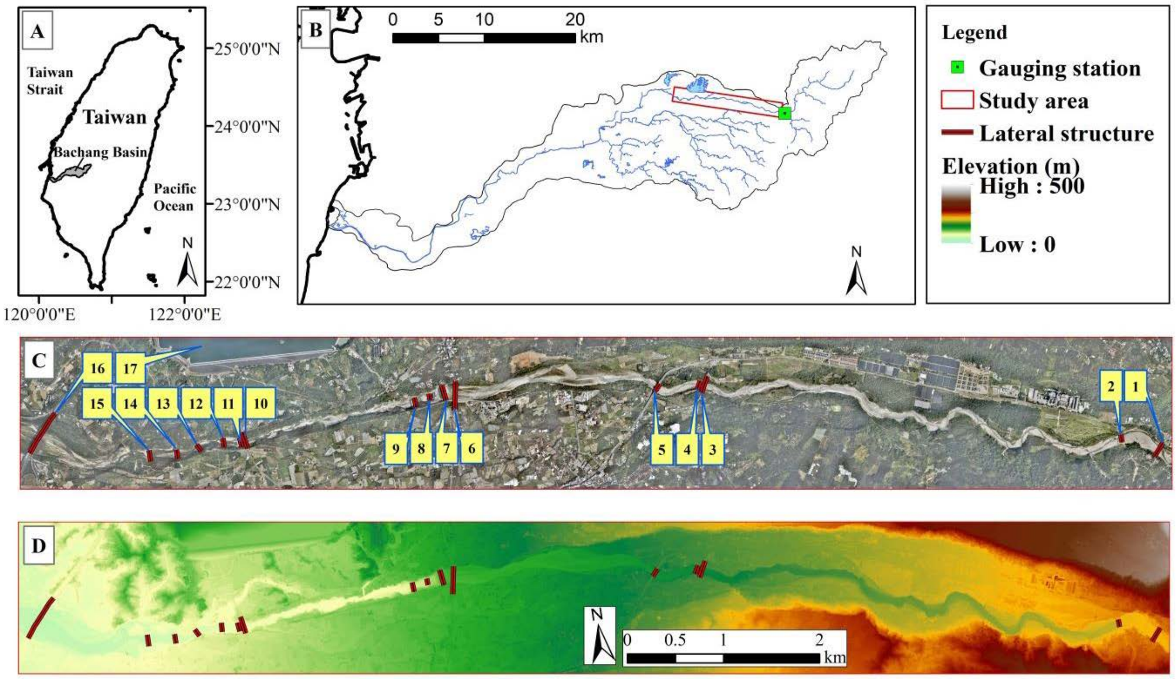

Figure 1: Geographical location of Bazhang river and the study site (Huang, 2014)

2. MATERIALS AND METHODS

Aerial photographic missions were started quite early in Taiwan. Besides those conducted before and during the WW-II, the first governmental aerial photographic agency was established in 1954. Routine photographic missions were carried out in later days. The aerial photos include those taken with analogue cameras, as well as those with modern digital cameras such as Zeiss DMC and Leica

ADS40. These images are provided through Aerial Survey Office, Forestry Bureau. All images are in digital format.

After 2002, airborne lidar missions are gradually becoming frequent. At this time, there are five surveying firms offer airborne lidar surveying services.

For this study, the data collected so far are listed in Table 1. The photographs are processed with Leica LPS (Now Imagine Photogrammetry) package, and also with BAE Socket GXP 4.1 (BAE, 2014). Aerial triangulation is performed first, then digital surface models are generated with automated matching schemes, also the orthophoto.

Table 1. Data Collected

Year	Type	Ortho photo spacing (m)	DTM spacing(m)
1981	Photogrammetry	0.25	1
1981	Photogrammetry	0.5	5、20
1983	Photogrammetry	0.25	1
1986	Photogrammetry	0.25	1
1989	Photogrammetry	0.25	1
1991	Photogrammetry	0.25	1
1991	Photogrammetry	0.5	5、20
1993	Photogrammetry	0.25	1
1997	Photogrammetry	0.25	1
1999	Photogrammetry	0.25	1
1999	Photogrammetry	0.5	5、20
2002	Photogrammetry	0.5	1
2006	Photogrammetry	0.5	1
2007	Photogrammetry	0.5	5、20
2009	Photogrammetry	0.5、1、2	2.5、5
2011	Lidar	0.5	1
2012	Lidar	0.5	1
2013	Lidar	0.5	1

3. ANALYSIS

Once the orthophoto and the digital surface model are generated, the analysis could be separated into two approaches, the horizontal, and the height. For the horizontal approach, schemes basic on matching could be applied. There are several different procedures. Tseng and Hu (2009) applied PIV (Particle image velocimetry) technique, which was documented in Adrain (1991). Leprince et al. (2007, 2008) devices another schemes named COSI-Corr. There are even more studies reported on the analysis with height. Young et al. (2006a, b), Gregory (2006), are all based on analyzing height. Among all these, Oslen et al. (2012) offered the compartment approach,

4. CONCLUSION

While historic photographs could provide a source of digital model in three dimensions, how to select control points becomes a critical issue. The older the photograph, the more difficult to select common points. Not just caused by the nature change, but also coupled with the datum shift. Instead of processing the block individually, the concept of fusion may be worthwhile for further exploration. Regarding the analysis schemes, both those based on horizontal feature matching and those based on height differences, could provide insight of the geomorphological changes.

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REFERENCES

[1] Adrain, R. J., 1991. Particle-imaging techniques for experimental fluid mechanics, Annual Rev. Fluid Mech., 23:261-304.

[2] BAE, 2014. SOCET GXP User’s Maunal, GXP4.1, BAE Systems.

[3] Gregory, K.J., 2006. The human role in changing river channels. Geomorphology, 79(3-4), 172-191.

[4] Huang, M.W., 2014. Soft rock erosion, channel evolution and their impact during the channelization of an originally fluvial river bed, PhD dissertation, Department of Civil Engineering, National Chiao Tung University, Taiwan.

[5] Leprince, S., S. Barbot, F. Ayoub and J. P. Avouac, 2007. Automatic and Precise Ortho-rectification, Coregistration, and Subpixel Correlation of Satellite Images, Application to Ground Deformation Measurements", IEEE Transactions on Geoscience and Remote Sensing, 45(6), 1529−1558.

[6] Leprince, S., Berthier, E., Ayoub, F., Delacourt, C., & Avouac, J. P., 2008. Monitoring Earth surface dynamics with optical imagery. EOS Transactions AGU, 89.

[7] Olsen, Michael J., Adam P. Young, Scott A. Ashford, 2012. TopCAT—Topographical Compartment Analysis Tool to analyze sea cliff and beach change in GIS, Computers and Geotechnics, 45: 284-292.

[8] Tseng, C. H. and Hu, J. C., 2009. Non-catastrophic landslides induced by the Mw 7.6 Chi-Chi earthquake in central Taiwan as revealed by PIV analysis, Tectonophysics, 466:27-437.

[9] Young, Adam P., Scott A. Ashford, 2006a. Application of airborne LIDAR for seacliff volumetric change and beach sediment budget contributions. *Journal of Coastal Research*, 22(2): 307–318.

[10] Young, Adam P., Scott A. Ashford, 2006b. Performance Evaluation of Seacliff Erosion Control Methods, Shore & Beach, 74(4): 16-24.