

THREE DIMENSIONAL MODELING AND VISUALIZATION OF WEATHERED ROCK SURFACE

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ABSTRACT:

This study focused on the quantification of weathering process, i.e. morphology of weathered stone surface which could provide very useful information for the determination of different weathering rates of each minerals, by using digital photogrammetry and laser scanning. Stereophotography could not be applicable to this work due to the great difficulty of image matching of the highly irregular surface of stone. Laser scanning was very useful for direct scanning of the irregular and rough surface of stone but sometimes did not provide reliable data due to reflection on the specific mineral surfaces such as quartz and feldspar. Thus further work should be continued to develop certain type of interpolation method for such reflecting points.

1. INTRODUCTION

Stone weathering as a natural process is actually one of the most important factor controlling the durability (or structural stability) of stone monuments. Such weathering process can be divided into two groups, i.e. (i) physical weathering such as microcracking and disintegration, (ii) chemical weathering such as discoloration and dissolution of component mineral grains (Figure 1). Both weathering result in certain types of loss in volume of each mineral component. Differential weathering is a result of differences in activity of each mineral to the same cause of weathering. Any weathering factor normally has negative influence on durability of stone monument. Thus such loss of durability can be assessed quantitatively by the measurement of volume loss using digital image combined with 3D DTM of stone surface.

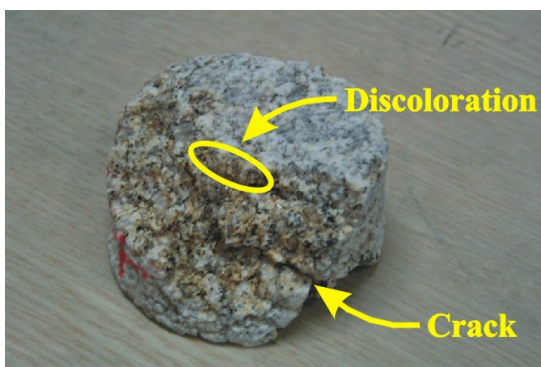


Figure 1. Stone influenced by both physical weathering and chemical weathering

2. COMPARISON OF METHOD FOR 3D MODELING OF STONE SURFACE

For 3D modeling of weathered (or unweathered) surface of stone, two methods have been considered, i.e., digital stereophotography and laser scanning. Digital

stereophotography is fast and convenient in data acquisition but can sometimes be quite difficult in processing of matching images for retrieval of 3D data, for the case of very complex surface. In fact, stone surface, whether it is weathered or not, is very irregular and rough compared to normal objects in the main photogrammetry.

Laser scanning, as a direct measurement method, is time consuming method in terms of data acquisition. However there is no need for post-processing of data. Thus it can be easily applicable to irregular and rough surface of stone.

3. 3D DATA ACQUISITION AND VISUALIZATION

3D morphological data has been acquired by flatbed style laser scanning method (Figure 2). Interval of movement in X and Y direction has been set up as 1 mm which can be suitable for the modeling of medium to coarse grained rock such as granite (the most widely used stone material in monuments in Korea). Surface image has been acquired by digital camera (Kodak DC290) which has been also used for 2D data acquisition of stone surface (Chang, 2001; Chang & Park, 2001)

Then it was draped to visualize the influence of weathering on surface morphology of stone (Figure 3). Differences in color and relief of each mineral grain could be useful for further identification of specific characteristic and behavior of mineral to weathering. If more measurement is conducted after further weathering, each volume loss of mineral grain can be easily calculated and then be used for further analysis of differential weathering rate of each minerals, which leads to quantitative assessment of durability of important stone monument.

4. CONCLUSIONS

Although 3D draped image has been easily acquired, there has been potential problems in data acquisition in laser

scanning, especially due to reflecting surface of certain minerals such as quartz and feldspar which are main component of granite. Same problem can also be expected if laser scanning is adopted in the case of marble and some limestone. Thus further work should be concentrated on developing averaging method of unexpected 3D point data caused by reflectance. Continuation of this study will include other optional method of data acquisition for stone surface.

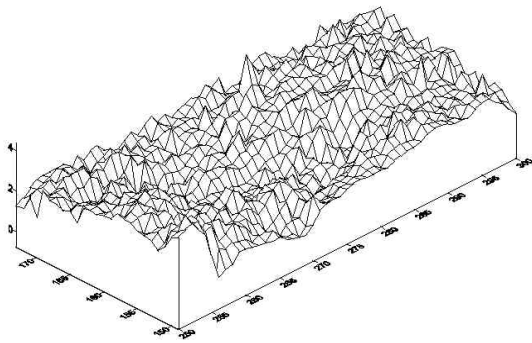


Figure 2. 3D morphology acquired by laser scanning

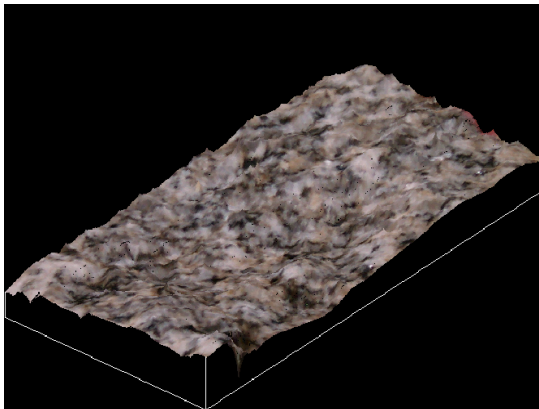


Figure 3. Visualization of stone surface

5. REFERENCES

- Chang, Y.S., 2001, *Image Processing of Visual Information Acquired from Rock Surface*, MSc Thesis, Seoul National University, 110p.
- Chang, Y.S. and Park, H.D., 2001, *A Classification Method of Deteriorated Stone Monuments Using Image Processing*, CIPA 2001 International Symposium, Potsdam, Germany, pp.28

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