Close-Range Photogrammetry For Landslide Monitoring

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1. Introduction

In today's industrial society, it has become increasingly important to prevent the pollution of our Photogrammetry has been defined by ASPRS (the American Society for Photogrammetry and Remote sensing) as the art, science, and technology of obtaining reliable information about physical object and the environment through processes of recording, measuring, and interpreting photographic images and patterns of recorded radiant electromagnetic energy and other phenomena (Wolf et al 2000).

In general, close-range Photogrammetry is a technique of representing and measuring 3D objects using data stored on 2D photographs, which are the base for rectification (Vesna, 2008). In order to obtain 3D information, the two photographs of the same objects are necessary. Close-range Photogrammetry is a part of terrestrial Photogrammetry but has dissimilarity in camera to object distance. In the close-range Photogrammetry, the limitation of camera to object distance is less than 100m (Cooper, 2000). Close-range Photogrammetry is mostly used for deformation measurement of structures, architectural mapping, modeling buildings, documentation of artifacts, reverse engineering purposes, or remodeling traffic accidents and crime investigation. Architectural and archaeological Photogrammetry is the example of close-range Photogrammetry application that is widely being used since the 1960s (Dallas, 1996).

The technique was implementing from stereo aerial Photogrammetry and continuously developed parallel with the advancement of computer and digital technology (Atkinson, 2001). Images on close-range Photogrammetry can be captured using three types of camera: metric camera, semi-metric camera, and non-
metric camera (Hanke et al. 2002). Measurement by using this digital camera offers low cost, an alternative in mapping data collection tools.

The accuracy of photogrammetric depends on camera resolution, quality of camera calibration, geometry of the camera position, and the precision of marking the location of the images (). Most of the Photogrammetry work needs accuracy in the project. High accuracy work requires a well calibrated camera. Landslide on the slope area can be well detected by calculation of DEM from at least two different epoch data, or by profiling of longitudinal section or cross section over the DEM observed slope area.

2. Methodology

To demonstrate the capability and effectiveness of the application close-range Photogrammetry as a data acquisition tool in generating DEM and inaccessible landslide monitoring areas. The objectives of the research are:

i. To generate DEM model by using the data from observing monitoring areas by using the close-range Photogrammetry technique as a data acquisition tool.

ii. To conduct an accurate and data sampling from close-range Photogrammetry technique.

To produce an integration of close-range Photogrammetry and GIS analysis as well as how such information can be integrated to improve our theoretical knowledge about landslide and mass-movement monitoring.

2.1. Technique of observation

Data Preparation and Collection for camera calibration process

The calibration grid is a pattern of dots specifically designed for the camera calibrator. There are a number of ways to set up the grid for photographs, depending on the size needed and suitable equipment. The grid has two categories:

i. Has large target dots and suited for calibration for video and lower resolution cameras.

ii. Has small target dots and suited for calibration for any camera over 6 megapixels

iii. Recommended from Photomodeler Pro 5 to print with suitable modeling. If the model is small, it can quickly be printed on a standard piece of paper. If the model is large, try to make the calibration grid larger.

2.2. Data Processing

For the purpose of calibration, there are four positions in this process. For position one, at 0 degrees, takes a picture of the grid in the landscape. Next, take a portrait photo by rotated 90 degrees, from the same position. Repeat the same step until finished at four positions of the camera.

In this study, all the photographs from the digital camera have been downloaded into the computer, image measurement is carried out. All the photographs of the test were measured using close-range Photogrammetry software. This software can be used to determine the camera calibration parameters.

Ideally it can calibrate with the same focus setting the same distance from camera to object to use in this research. It easy way to set-up calibration for user. Taking photographs of the Photomodeler Pro 5 calibration grid by using 8 photos are taken of the grid from set positions.
control points needed to rectifying process and it needs six control points in producing 3D. A flowchart of Figure 3 below describes the phase taken to establish ground control point (GCP) process.

The equipments used for established control points are one total station (Laser Reflectorless GTS -750 series), two tripods, prism and measuring tape

It is important to choose the most suitable software which has the ability that suit the function of the research. The software is chosen based on the ability of the tools for the input and manipulation of geographic information, the ability of managing the database, a tool that support geographic query, analysis and visualization. For the purposes of this research, PhotoModeler 5 is software that being used in processing spatial and attributes data in this research (PhotoModeler, 2009).

C. Fieldwork Process and Establish Control Points.

The most important step to be carried out in this preliminary work is establishing the control point of the study site located at Seri Iskandar, Perak. It is needed to rectify images and producing 3D model. At least three or four
the base contour is the contour from which contouring starts. Suppose a DEM has elevation readings ranging from 44.883-62.628 meters. The concepts of 3D modeling description of the shape of an object by determination of its main frame of reference and if required, creation of the textural database for the selected surfaces of the structure.

The arrangement and pattern of contour lines reflect the topography. For example, contour lines are closely spaced in steep terrain and are curved in the upstream. Each commercial software has different advantages in processing the data. No measurement technology can be perfect and all measurements involve performing approximation. ArcGIS 9.0 is no different. Not all the 3D coordinates result can be of the same quality.

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3. Results and discussion

The result of processing consists of Camera focal length, size of the position, and RMS. The calibration stage starts, where the camera parameters are calculated. The progress bars as the calibrator works. It completes the first pass of estimated camera parameters. As long as the points are greater than 10, it should be OK. It then does one more calibration process and the project is completed.

The result of processing data from the study site consist three dimensional points that have coordinated values for each of the Cartesian axes (X, Y, and Z). A 3D model is a set of connected 3D points, edges, curves and cylinders or shapes represent an object. Figure 6 below represent the result of 3D image generated from the collected data from the field site. A DEM represents a regular array of elevation points. The quality of a DEM can influence the accuracy of terrain measures including slope and aspect [29]. Slope and aspect play regular role in hydrologic modeling, snow cover evaluation, soil mapping, landslide delineation, soil erosion, and predictive mapping of vegetation communities [29].
Figure 10 and Figure 11 show the slope and Aspect Model from three dimensional points that represent from the epoch data 1. The slope measures the rate of change of elevation at surface location. Slope may be expressed as the percent slope or degree slope. In this paper, the result of slope is shown in degrees. Aspect Model is the directional measure of slope. Aspect start with 0 degrees at the north moves clockwise and ends with 360 degree also at the north. Slope and aspect used to be derived manually from contour map. At the end of the study the results will show the performance of close-range Photogrammetry generated an integration of GIS analysis as well as how such information can be integrated to improve our theoretical knowledge about landslide monitoring.

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References


