Ground Survey by means of Unmanned Helicopter

River Management Department,
Kinki Regional Construction Bureau

1. Introduction

It is often, in dealing with projects for erosion control and disaster rehabilitation, rather difficult to launch a manpower-intensive project because workers are obliged to risk their lives at the sites. Especially in the case of disaster rehabilitation project, the sites might be prone to secondary disaster due to subsequent hazardous events.

Figure 1. Location map

In order to avoid risks of secondary disasters, specific technologies using remote controlled systems which allow unmanned operations for construction works have been developed and employed in the field. Similar technology must be developed, further to operations for construction works, and applied for ground survey projects which some times target inaccessible areas.


Photo 1. Unmanned Radio-controlled helicopter

Technology of ground survey using radio-controlled unmanned helicopter is quite appropriate for the areas especially on the slopes which are prone to subsequent hazardous events such as rock falls and landslides. This report presents the results of the operation for ground survey using unmanned radio-controlled helicopter in the disaster site in Ohno City, Fukui Prefecture.

2. Outline of the project site

The project site is located in the basin of the Kumokawa river which is a tributary of the Managawa river in the Kuzuryu River basin in Fukui Prefenture.

A landslide of 70 meters wide, 200 meters long and 160 meters high took place on the right bank slope a 3 kilometers upstream from the confluence point with the Managawa River on June 11, 2001.


Photo 2. Bird's-eye view of landslide

As much as 30,000 cubic meters debris was produced and the lower end of the massive sediments entered into the channel of the Kumokawa River.

Subsequent erosion at the lower end of the debris might result in another landslide on the slope.

Although erosion prevention works using steel gabions had been launched immediately after the landslide, the large flood of July 2004 washed them away. Subsequent landslide took place and the slide areas were expanded as a result. A new project is therefore required to prevent further expansion of the slopes.

3. Outline of the technology employed

The radio-controlled helicopter equips with a high-precision three dimensional lazar scanner and a pair of ground positioning systems (GPS). The high-precision three dimensional lazar scanner is used to file digital images and the GPS is used to identify and record the flight course.

Data acquired by the GPS device installed in the helicopter are corrected by another GPS installed on the ground.

The error of the three dimensional data is therefore reduced lesser than 2 centimeters.

Laser beams created by the laser scanner installed in the helicopter are radiated by rotating mirror and provide digital data on targets on the ground. Three dimensional data converted from radar echo offer the precise data for topographic mapping.

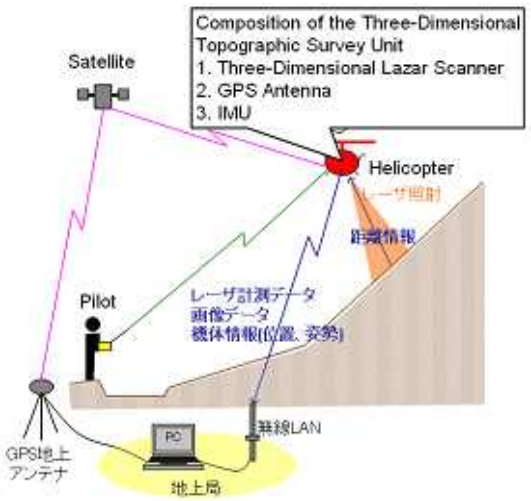

Figure 2. System composition for the survey

The features and advantages of the unmanned survey employing this technology are as follows:

a) Free operation is possible regardless of day or night. No flight permission is required and an operation is possible even in the crowds.
b) All the flight can be programmed. Unmanned flight has nothing to do with injury accident.
c) High precision survey is possible by hovering flight.
d) Helicopter allows to get close up to shoot and monitor targets. High resolution images of targets without any blind spot are therefore guaranteed.
e) Images and data can be displayed on the monitor in real time.

4. Effects of the operation

A lot of mobile materials detached from the slope posed a serious concern about another disaster due to rock fall. It was therefore too risky to dispatch a survey team to cover the target areas, but precise topographic data on the target slope were indispensable to launch a project for slope protection. Taking into account the high risks of accidents, unmanned operation was required.

The target area was however too small to conduct ordinary air photograph survey by means of either helicopter or aircraft which required rather high cost. Furthermore, the precision of the image and data acquired by an ordinary air photograph survey is not sufficient. Morphologic features of the target area did not allow the use of three dimensional laser radiated by the system

installed on the ground.

The only measure left was a ground survey by means of radio-controlled unmanned helicopter.

5. Operation and results

The survey work, except control point survey for data examination, by means of unmanned helicopter required only several hours. Although another several days were required for data analysis, the period from the beginning of the survey work to the delivery of the products was shorten compared to the survey work by means of ordinary survey technologies.

The height accuracy of the survey this time was identified approximately 80 mm while the machinery error derived from GPS, gyrocompass and lazar scanner were ±20mm, ±25mm and ±30～50mm respectively. Both GPS and lazar scanner are responsible for positioning error and gyrocompass is responsible for the error due to attitude control.

The technologies leave much to be improved especially in cost and versatility, but it is certain that the technology is applicable to the survey on the changes in cross sectional profile and longitudinal profile of rivers.

※Translated from Journal of Japan Sabo Association, Sabou to Chisui, Vol.169, pp.26-27, 2006