Utilization of 3D Topographic Data in the River Field and Expected Effect

(Research period: from FY2017)

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Keywords: laser survey, 3D topographic data, levee inspection

1. Progress of surveying technology and utilization in the river field

At present, for inspection of river levees, two or more inspectors walk along the levee to find deformation in the levee surface, such as slope collapse or animal nests. This method, however, requires a lot of personnel and time, so that establishment of an effective and efficient inspection method is sought.

On the other hand, a remarkable technical progress is seen for laser surveying instrument, including improvement in survey accuracy and miniaturization of equipment. The following reports the result of applying 3D topographic data obtained with the laser surveying instrument to inspection of the river levees as an example of utilization in the river field.

2. Detection of deformation in levees using 3D topographic data

We tried to detect deformation in the levee of the Maruyama River, running through the north-eastern part of Hyogo Prefecture (right levee, 9.2 km -10.2 km) with the 3D topographic data obtained from an unmanned aerial vehicle equipped with a laser surveying instrument ("UAV laser") and a large weeder ("weeder laser"). Specifically, we prepared five types of maps from the obtained 3D topographic data, "Contour map", "Inclination map", "Gradient tints map", "Shade map", and "Underground openness map," which were all checked by 5 engineers who are skilled in levee inspection and have a qualification of river inspector or other to confirm whether any deformation as target of inspection could be read from them. As a result, the mapping method by which the maximum number of deformed spots was found out was the inclination map (Fig. 1). The inclination map represents the amount of tilt in the topography and was found to easily detect mole holes, gullies, subsidence, etc.

Fig. 2 shows the types and number of deformed spots that could be read from the inclination map above. Fig. 2 also provides, for comparison, the result of normal visual inspection. Deformation with long depth compared with area, e.g., mole holes, is often found, while deformation with short depth compared with area, e.g. temple roof slope (a slope that is steeper and bends more upward as closer to the top, like the roof of a temple) is difficult to detect since the amount of tilt does not greatly change.

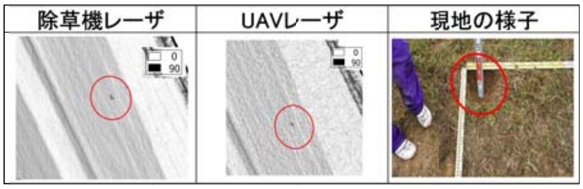

Fig. 1: Inclination map showing the periphery of deformed area and state of the site

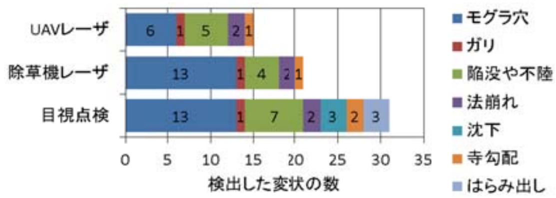

Fig. 2: Comparison of the result of interpreting the inclination map of deformation and the result of visual inspection

It was also found that the number of deformed spots detected was different in the weeder laser surveying because its survey score is about 100 times that UAV laser and enables creation of an inclination map representing small deformation.

3. Prospect of future utilization

The result of this study suggested the possibility that deformation of levees could be detected from the 3D topographic data. In order to use 3D topographic data for improving the efficiency of conventional inspection, further improvement in detection accuracy and detection of deformation without topographic changes, such as poor vegetation are required.

We intend to continue the study including the possibility of technique for automatic detection of deformation in levees with machine learning of 3D topographic data.

☞**See the following for details.**

1) "River levee condition visualization technology", SAT TECHNOLOGY SHOWCASE 2019 http://www.science-academy.jp/showcase/18/pdf/P-081_showcase2019.pdf