Data acquisition and analysis of three-dimensional resistivity survey by means of a distributed resistivity measurement system

*Hiroshi Kisanuki[1], Ken Sakurai[1]

1. OYO corporation

Three-dimensional resistivity survey by means of a distributed resistivity measurement system was conducted to assess a usability of this new measurement system. Three-dimensional survey is the most effective method for evaluating underground structure accurately compared to one-dimensional and two-dimensional surveys. However, there are some issues for applying three-dimensional survey to geological investigation. For example, it requires a lot of measuring tools and takes a lot of time for data acquisition and processing.

The new system consists of two independent measuring parts which are transmission and reception ones (Truffert et al., 2017). The two parts are synchronized each other with GPS clock. Therefore, this system doesn’ t need to connect all electrodes with measuring instruments. In other words, long and heavy multichannel cables are unnecessary. We expected that this point enables us to save a quantity of work dramatically.

The survey was carried out at OYO Tsukuba site. The survey area was 48 m in length and 48 m in width. We used a total of 16 receivers and injected current at 40 points. One receiver can record 2 channels by using three electrodes. They were set in L-shape at 4 m spacing.

As a result, a total of 1280 data was obtained. A few data showed negative apparent resistivity. Generally, resistivity inversion uses the logarithm of apparent resistivity as the data parameter. If negative value contains in the data, inversion process fails. In order to solve this problem, the new inversion process was proposed by Loke et al(2019). In this process, the data were converted to amplitude and direction by composition of two direction data which was obtained by one receiver. We incorporated this new inversion process to our software which we have been developing. The inversion process could execute stably because amplitude showed always positive value.

In conclusion, the new measurement system was useful for designing electrode arrangement and setting measurement tools because this doesn't need to connect all electrodes with several multichannel cables. In addition, the new inversion process was effective for the dataset which contained negative apparent resistivity.

References:
Truffert, C.M., 2017, A new distributed and cable less system for large 3D electrical resistivity ERT and induced polarization tomography : 9th Congress of the Balkan geophysical society.
Loke, M.H., Gance, J., Truffert, C. and Leite, O., 2019, The inversion of vector array data sets for 3-D resistivity and I.P. surveys : 25th European meeting of environmental and engineering geophysics.

Keywords: resistivity survey, three-dimensional

