Development of a prototype of radiation-spatial information data linkage analysis integrated system

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***Keywords : It is recommended that the number of keywords does not exceed five.**

1. Introduction

In this paper, we developed an integrated mobile equipment for simultaneously performing precise three-dimensional spatial information measurement and radiation measurement in order to improve the accuracy of unmanned radiation environment measurement technology. If the equipment developed in this paper is used for multi-spatial characterized manned measurements or unmanned remote measurements, it is possible to apply correction technology according to the site topography based on the surrounding three-dimensional spatial analysis and improve the measurement accuracy [1-2]. For this reason, this equipment was developed to obtain highly accurate data of the dose rate at the instrument location and the dose rate on the surface of the surrounding space by simultaneously measuring the three-dimensional spatial information of the radiation instrument and its surroundings.

2. Material and methods

This section describes the components of the radiation-spatial information data linkage analysis integrated system. This system consists of radiation measurement equipment and 3D spatial information measurement equipment.

7.1. Radiation measurement equipment

The radiation measurement equipment used in the construction of this integrated system is a multipurpose radiation measurement system called MARK-M1 (Monitoring of Ambient Radiation by KAERI-Multipurpose 1). The system uses two pairs of $LaBr_3$ detectors and MCAs, and consists of a signal processing unit, a GPS positioning unit, a laser altimeter, a Bluetooth-based interface unit for data communication with a PC on the ground, and a USB data transfer cable. The MARK-M1 instrument weighs approximately 6.2 kg without the battery. Figure

Fig. 1. MARK-M1 equipment

7.2. 3D spatial information measurement equipment

The LiDAR equipment was used for 3D spatial information measurement to create an all-in-one device. The LiDAR equipment is mainly divided into a lidar head (laser generation and measurement equipment), a LiDAR PC body, and a battery pack. The LiDAR head is Velodyne Inc. product from the United States and is connected to the LiDAR PC. The LiDAR equipment weighs about 1 kg and uses a 16-channel LiDAR sensor that can measure up to 100 meters away. It can measure up to about 300,000 points per second. The battery pack is a 16.8V voltage, lithium-ion battery.

Fig. 2. Picture of LiDAR PC and LiDAR head

7.3. 3D radiation mapping optimization program

We designed the hardware combination of MARK-M1 and LiDAR, and after hardware integration, we used an LTE communication module for organic connection of the two devices and smooth data communication with the control PC. In addition, a 3D ROP (3D Radiation mapping Optimization Program) program was developed to control the two devices,

receive data, and analyze the data. The 3D ROP program is an open source Cloud Compare-based program that visualizes the radiometric position and radiation data on the three-dimensional image of the LiDAR and has editing functions. In addition, this program supports the transmission and reception of data through LTE communication using LiDAR equipment and control PC as client and server, respectively.

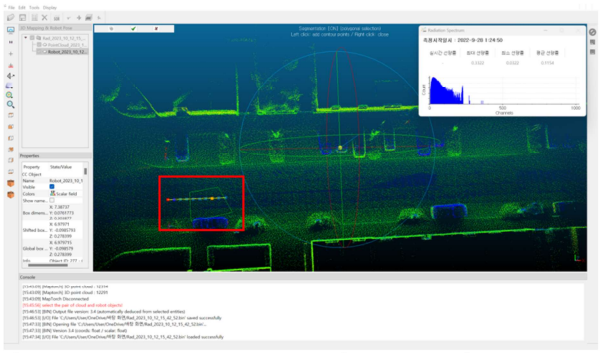

Fig. 3. 3D ROP program operating screenshot

3. Conclusions

The results of this field experiment are expected to contribute to the evaluation of the applicability of environmental radiation detection and evaluation technology to accident sites and the improvement of the technology. In the future, we plan to conduct operational experiments at actual radioactive contamination sites, as well as field experiments to improve the accuracy of the analysis technology and perfect the equipment by conducting foot and aerial surveys.

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