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福島県の放射性セシウムの土壌汚染エリアにおける無人ヘリコプタを使った遠隔測定
Remote radiation monitoring of radioactive cesium by unmanned helicopters at the soil contaminated area in Fukushima

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By the nuclear disaster of Fukushima Daiichi Nuclear Power Plant (NPP), Tokyo Electric Power Company (TEPCO), caused by the East Japan earthquake and the following tsunami occurred on March 11, 2011, a large amount of radioactive materials was released from the NPP. An emergency radiation monitoring, in order to evaluate the effects of such radiation on the surrounding environment, as well as ground measurements were conducted from the sea and air. As a means of radiation monitoring from the air, aerial monitoring using manned helicopters was conducted in the whole area of East Japan. Although manned helicopters can monitor a large area in a short time, flight at an altitude of 150 m or lower is prohibited by the Aviation Law in Japan. Therefore, it is difficult for a manned helicopter to measure the radiation profile near the ground and to measure the radiation level in a complicated terrain. In recent years, technologies for autonomous unmanned helicopters (AUHs) have been developed and applied to natural disasters. In expectation of the application of the AUHs to aerial radiation monitoring, we had developed a remote radiation monitoring system. Then, we measured the radiation level by using unmanned helicopter in soil contaminated areas by radioactive cesium emitted from the NPP to evaluate ambient dose-rate distribution around the areas and to investigate the decontamination effect by the measurements before and after decontamination treatment. Here, we reports on the measurement technique and the result.

This system we used is mounted a plastic scintillation detector (size: 270 x 300 x 20 mm) on the AUH (RMAX G-1, Yamaha Motor Co., Ltd.), and can fly for the destinations and return by the automatic operation, and the radiation data can be measure during the flight. Radiation data are transmitted immediately with image and position data to the monitoring station on the ground. It is possible to monitor these data on the map of the computer display in the real time. At this time, we have fled the AUH at 30 - 50 m high above the ground in the contaminated areas around the NPP. Furthermore, this system was also installed two GPS sensors on the AUH, and measured the latitude, longitude, and the flying altitude at the same time. The flying altitude from the ground was obtained by subtracting the altitude obtained by the DEM (digital elevation model) data from that of the helicopter. The attenuation coefficient of air was obtained by flying at some altitudes (5 - 50 m) in above the test-line selected for the comparison with the ground data. Moreover, the conversion coefficient of the ambient dose-rate was calculated by the comparison of the ambient dose-rate measured by an NaI survey-meter with the counting rate at 1m height evaluated by using the attenuation coefficient. Finally, we made maps of ambient dose-rare distribution from the analyzed results of radiation by using a GIS software.

In addition, we developed a system using a manual operated unmanned helicopter to fly complex terrain and measure the radiation in narrow areas. In this system, both a CCD camera and a GPS sensor are installed besides a radiation detector using a plastic scintillator, we can measure the radiation, the monitoring position and image in real time.

We present the outline of these systems and the measured results obtained in Fukushima Prefecture.

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