Development of HYPERGAM for Ambient Gamma Radiation Monitoring

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1. Introduction

HyperGam, a new HPGe γ-ray spectrum analysis software, has been developed [1]. In the followed work, MCA emulation function was added to the HyperGam package to use it as an on-line spectrum acquisition and analysis software [2].

In this work, several functions are added to use the HyperGam as a tool of automatic spectrum acquisition and isotopic analysis for ambient radiation monitoring in ERMS (Environmental Radiation Monitoring System). The developed features include on-line acquisition of gamma spectrum, automatic identification of nuclides, individual peak monitoring and network communication functions.

2. Features

For an ambient gamma radiation monitoring, the HyperGam program used in the analysis of HPGe gamma-ray spectrum has been modified. The main functions are automatic nuclide identification, MCA emulation and peak monitoring.

The automatic algorithm of nuclide identification is implanted in the HyperGam. It is based on identifing the peaks on the spectrum by considering the yield, efficiency, energy and peak area of the gamma-ray line from radionuclide. Figure 1 shows overall process of the nuclide identification. The library data required for the nuclide identification was taken from EML (Environmental Measurement Laboratory) [3]. At the analysis data stage, peak analysis result of gamma-ray spectrum is loaded with a pre-determined channel-energy calibration. Primary candidate nuclides are selected based on the peak energy, and CM (Candidate-Matching) and NM (Nuclide-Matching) matrices which are prepared by using the analysis data. Ratio, detection and energy tests are conducted by considering with the analysis data of the gamma-ray spectrum. From the test results, the probable candidate nuclides are listed, and the most probable nuclide is determined finally.

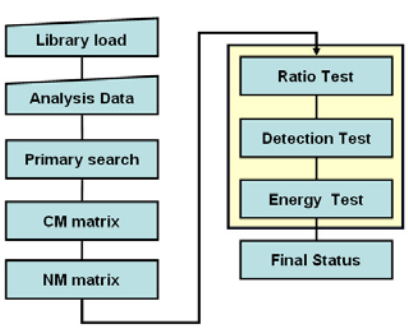

Figure 1. Flow of nuclide identification algorithm.

Executing MCA emulation function, and continuous acquisition and analysis of spectra can be automatically performed. The monitoring menu of the HyperGam is shown in figure 2. Major functions are as follows: In the detection setting part, users can select detector, MCA device and the conversion gain among the available setting given by the acquisition device. In the monitoring option setting part, monitoring and refresh interval time are input. In the peak monitor part, count rate, resolution and position drift of interested peaks can be monitored (figure 3). Users can also check the fluctuations in dose rate and conditions of devices such as cooling and high voltage system during the gamma-ray measurement. These functions were tested for the acquisition devices of ORTEC EtherNIM 919E, DSpecpro and DigiBase model.

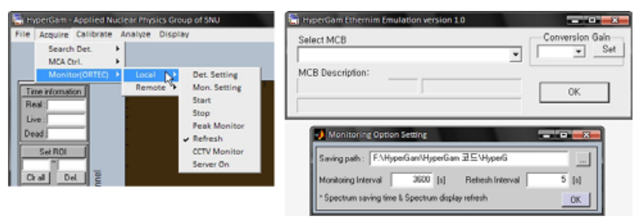

Figure 2. The monitoring function of HyperGam.

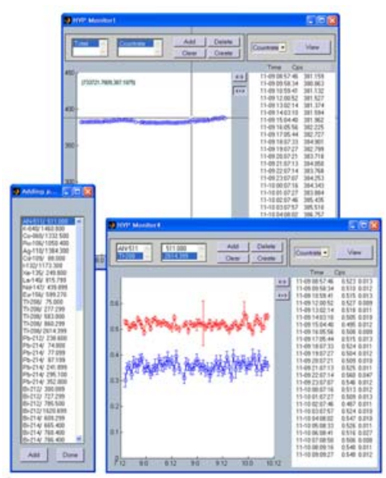

Figure 3. Peak monitoring windows of HyperGam.

To monitor gamma radiation at a remote site, network communication function was embodied to the HyperGam, written in C++ language based on TCP/IP socket programming. In figure 2, local menu can be used in the server computer (SC) which is directly connected to the acquisition devices, while remote menu can be used in the client computer (CC). Both computers are connected via the network. Users connect and read-out a real-time spectrum data from the SC by using remote menu, but the SC should be on standby status by 'Server on' execution before the CC connection. During the monitoring, spectrum data are loaded and displayed at the refresh rate and saved automatically as text file (*.spe) in the same manner as the monitoring in SC.

3. Conclusion

An automatic algorithm of nuclide identification is implanted in HyperGam. It has been developed to identify the peaks on the spectrum by considering yield, efficiency, energy and peak area of the gamma-ray line of radionuclide. Additionally, an automatic monitoring function for ambient gamma radiation has been successfully added to HyperGam. Hence, it is now possible to control acquisition devices, to display loaded spectrum and to analyze the spectrum routinely by using the MCA emulation and nuclide identification functions. A network communication function is included to use the HyperGam at a remote distance from the detection site.

ACKNOWLEDGEMENTS

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