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ARTIFICIAL NEURAL NETWORKS IN THE EVALUATION OF THE RADIOACTIVE WASTE DRUMS ACTIVITY

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The mathematical techniques are becoming more important to solve geometry and standard identification problems. The gamma spectrometry of radioactive waste drums would be a complex solution problem. The main difficulty is the detectors calibration for this geometry; the waste is not homogeneously distributed inside the drums, therefore there are many possible combinations between the activity and the position of these radionuclides inside the drums, making the preparation of calibration standards impracticable. This work describes the development of a methodology to estimate the activity of a 200 L radioactive waste drum, as well as a mapping of the waste distribution, using Artificial Neural Network . The neural network data set entry obtaining was based on the possible detection efficiency combination with 10 sources activities varying from 0 to $74x10^3$ Bq. The set up consists of a 200 L drum divided in 5 layers. Ten detectors were positioned all the way through a parallel line to the drum axis, from 15 cm of its surface. The Cesium-137 radionuclide source was used.

The 50 efficiency obtained values (10 detectors and 5 layers), combined with the 10 source intensities resulted in a 100,000 lines for 15 columns matrix , with all the possible combinations of source intensity and the Cs-137 position in the 5 layers of the drum. This archive was divided in 2 parts to compose the set of training: input and target files. The MatLab 7.0 module of neural networks was used for training. The net architecture has 10 neurons in the input layer, 18 in the hidden layer and 5 in the output layer. The training algorithm was the 'traincgb' and after 300 'epochs' the medium square error was 0.00108172.

This methodology allows knowing the detection positions answers in a heterogeneous distribution of radionuclides inside a 200 L waste drum; in consequence it is possible to estimate the total activity of the drum in the training neural network limits. The results accuracy depends on the way that the waste drum is divided and to the amount of intensities that it is interpolated between the minimum and maximum limits. The use of the Artificial Neural Networks associated to Monte Carlo Method showed to be efficient in the isotopic characterization of radioactive waste drums.