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#7-51 Nuclear Waste Characterisation using Bayesian approaches

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The relance of the nuclear industrial sector in France is an ambitious plan expected to meet the energy needs of the general public in the 21st century. Along with the construction of new nuclear power plants, significant steps are being taken in the fields of the nuclear fuel cycle and nuclear waste management. In order to comply with the criticality limits, nuclear waste is stored in special drums and different types of nuclear measurements are employed in order to determine the amount of the nuclear matter (U, Pu) contained inside them. These measurements are an indispensable part for various fields of the nuclear industry and active research is ongoing on new methods for improving their precision, especially on the statistical analysis of the data and the modeling of the measurement techniques. In this work, we present an experimental design for the measurement of waste drums using the SYMETRIC 3He detector array located at CEA Cadarache. Simulated data have been produced for different parametrisations of waste drums in order to establish a model that has the potential of sufficiently predicting the calibration coefficient CP9, which is directly related to the amount of fissile matter inside the drum. This coefficient serves as constant of proportionality between the measured prompt signal and the equivalent mass of 239Pu contained in the drum. Up until now, the models trained by the simulated data of the experimental design were exported by multiple linear regression. In an attempt reduce the statistical uncertainties, Bayesian non-parametric methods, such as the Gaussian process, have been tested in the present work. Such methods offer a direct measure of the model uncertainty and are ideal for relatively small datasets. The results are compared with other methods, such as multiple linear regression and Kernel ridge regression. The present work can serve as a starting point for the application of more advanced machine-learning algorithms in view of a better model description along with a potential reduction of the uncertainties.

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