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Data driven techniques to analyse gamma-ray spectra from the London SIGMA sensor network

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Sensor networks continue to define measurements across the field of environmental monitoring, including that of radiation detection. NuSec and AWE's SIGMA Data Challenge provides access to measurements of gamma-ray activity recorded by a sensor network of around 100 detectors distributed across central London. We have analysed data from three detectors centred around St Thomas' Hospital and more than 10 detectors in a 'local' vicinity around Waterloo Station, Charing Cross and Westminster to identify anomalies in the data that may be linked to anthropogenic disturbances.

Initially, data driven techniques were used to analyse the gamma-ray spectra of the three detectors located in St Thomas' Hospital. The temporal correlations between these three detectors were investigated by subtracting average gamma-ray activity to look for relative peaks and troughs over small timespans for each detector. The days over which the data was investigated correspond to those used in the testing of the GROUSE algorithm (Garrood J. et al, 2023). Additionally, the methods of background subtraction featured in the GROUSE algorithm were also investigated and compared a variety of other methods for sampling an average background.

Both spatial and temporal correlations of peaks in gamma-ray spectra were considered when expanding the sensor network to over 10 detectors centred on St. Thomas' hospital. A 2D heat map was created to illustrate peaks in gamma-ray spectra across multiple detectors in this area over a given time. Gaussian processes (Sousa and Forbes, 2024) and Machine Learning techniques can be used to further probe the spatio-temporal correlation in gamma-ray spectra peaks across the given area.

Through these data-driven techniques, we will demonstrate the extent to which relative peaks in gamma-ray spectra are correlated both spatially and temporally. We will also discuss if a conclusion can be made as to why this correlation occurs, either through environmental reasons or human intervention.

Garrood, J. et al. (2023) 'In-House Distributed RD Detection Algorithm Development' [PowerPoint Presentation] Available at: https://indico.cern.ch/event/731980/contributions/5584919/attachments/2729477/4744422/5%20MARTIN%20AWE_In_House_Distributed_RD_Detection_Algorithm_Development.pdf (Accessed: 21/01/2025)

Sousa, J.A. and Forbes, A.B., 2024. 'Gaussian processes and sensor network calibration', Measurement: Sensors, p.101512.

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