RAP 2023

INTERNATIONAL CONFERENCE ON RADIATION APPLICATIONS

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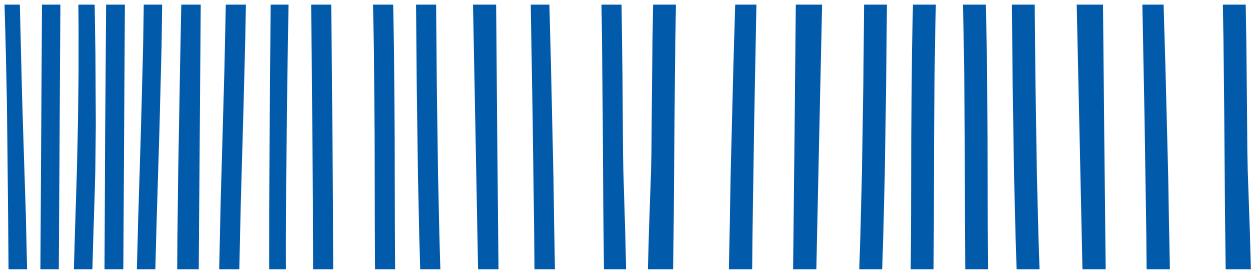
BOOK OF ABSTRACTS



May 29 - June 2, 2023 | Hellenic Centre of Marine Research | Anavyssos | Attica | Greece | **www.rap-conference.org**

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A Time Series Forest Method for automatic classification of anomalous glow curves of LiF:Mg,Ti based thermoluminescent dosemeters

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Thermoluminescent dosimetry is a widely used passive dosimetry method for estimating protection quantities i.e. the effective or equivalent dose. When the thermoluminescent dosemeters (TLD) are irradiated, they store the dose information through the processes of ionisation and subsequent trapping of charge carriers. The charge carriers in TLD crystalline material move from the ground state to the higher energy states (trapping centres) that are partially stable at room temperature. By heating the material, charge carriers leave the metastable energy states and recombine at recombination centres, emitting light (glow). The heating procedure gives rise to a glow curve (GC) – the light intensity as a function of temperature and time. By calibrating the TLD reader, the area under the GC is converted to a dose value (e.g., personal dose equivalent, $H_p(10)$). The shape of the GC depends on the time-temperature profile (TTP) defined for each TLD material separately and may be regular or possess some anomalies. Inspecting the GC shape, as one of quality control measures, is usually conducted qualitatively and performed by trained TLD service staff. Hence, this paper presents the implementation of the machine learning Time Series Forest (TSF) method for the classification of anomalous GCs of LiF:Mg,Ti based TLD.

TSF is a tree – ensemble method that combines entropy gain and distance measure for evaluating splits. This method shows significant computational efficiency compared to the well – known one – nearest – neighbour classifier. The dataset used for the TSF method consists of 201 normalized GCs exported by the software supplied with Harshaw 6600 Plus Automated Reader – WinREMS. The dataset is labelled into five different classes: (1) regular shape, (2) spikes at random positions, (3) TLD signal in the low – temperature region, (4) TLD signal in the high – temperature region, and (5) shift of the entire GC to higher temperatures. A random split of the dataset into training and testing in a 70/30 training/test ratio was performed, while the 10 – fold cross – validation was used for the hyperparameter tuning.

The results showed that the TSF method can classify four different anomalies for GC with an accuracy of 96% and a macro average F1 score of 96%. According to the obtained results, it is possible to conclude that the TSF is a promising candidate method that could be implemented as a new software package for automated GC quality control within the TLD service.

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