Actinides and Rare Earths
Room Ballroom BC - Session AC-ThP

Actinides and Rare Earths Poster Session

AC-ThP-2 Deep Fission Track Analysis for Nuclear Forensics, *Noam Elgad,* Ben Gurion University Be'er Sheva, Israel*;* ***Itzhak Halevy****, Rami Babayew,* Ben Gurion Uni. Be'er Sheva, Israel*; Mark Last, Itzhak Orion,* ben Gurion Uni. Be'er Sheva, Israel*; Jan Lorincik,* research centre rez, Czechia*; Yaakov Yehuda-Zada, Galit Katarivas Levy,* ben Gurion Uni. Be'er Sheva, Israel*; Aryeh Weiss,* bar-ilan university, israel*; Erez Gilad,* ben Gurion Uni. Be'er Sheva, Israel

Abstract Summary:
Fission Track Analysis (FTA) is a key method in nuclear forensics for detecting fissile materials. This study proposes a novel deep learning approach to automate the segmentation and classification of star-shaped patterns in microscopic images, reducing the need for manual analysis.

Methodology:
Using a U-Net fully convolutional neural network, the research focuses on identifying star-like features in microscopy. A custom simulation tool generated artificial star shapes for training, alongside a new, diverse image database. Models were trained separately for small stars (under 60µm, fewer than 10 branches, no black center) and larger, more complex patterns. An adaptive thresholding method was introduced to improve data labeling and background noise filtering.

Key Findings:
The model reached 92.04% accuracy for small star classification and an ROC AUC of 0.84. For multi-class tasks, it achieved 86.3% accuracy in distinguishing star quality and 82.63% accuracy in recognizing stars with varying numbers of branches. Advanced classification models reached an AUC of 0.90.

Conclusion:
This study shows that deep learning can significantly enhance FTA by automating star pattern detection and classification, offering a more efficient and accurate tool for nuclear forensic analysis.

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