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Characteristics of a PADC-based neutron dosimetry system developed at PSI

Several systems for neutron dosimetry using PADC (CR-39) detectors are commercially available and widely applied for personal dosimetry. These systems, however, generally rely on undisclosed algorithms and predefined detector types which limits the research applications or the ability to evaluate different detector materials with the same system.

To read out different PADC materials in the same reader, apply custom-made converters or specific track filtering techniques, a new neutron dosimetry system was developed at the Paul Scherrer Institute (PSI).

The objective of this work is to show the current status and characteristics of the system, which automatically identifies and scans 100 PADC detectors per frame using motorized stages and a microscope setup with a CCD camera. The system autofocuses on the detector surface through parameters obtained from a combination of grayscale analyses and fast Fourier transformations of the images.

A sequence of GPU-based morphological operations are applied to each image to identify elements appearing like neutron-induced tracks, which are coarsely filtered depending on the track parameters. Further track parameters are computed during the post-processing where the tracks in 6-10 calibration and background detectors are analyzed to create reference distributions of track parameters. Based on these reference distributions, a track resemblance value is evaluated for each element extracted from the detector images, and the element is eventually rejected or accepted as a track. Hence, as the dose algorithm relies on the unique set of reference track parameter distributions, it is independent of a specific detector material, converter, or etching procedure.

The new neutron dosimetry system at PSI is able to scan different PADC detector types, separate the track densities detected below converters, and evaluate the dose of commercially available detector materials.

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