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Event-Mode Imaging for Improved Spatial Resolution in Fast Neutron Imaging

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Event-Mode Imaging is a method where the final image is obtained as a summation of individually acquired particle interactions. In fast neutron scintillators, scattering of the high energy neutrons generates recoil protons. Ionization by the protons leads to creation of visible light in the form of a cone. The low spatial resolution in fast neutron imaging results from blurring introduced by the cone shape emission of light with the spatial resolution roughly proportional to the thickness of the scintillation material. To overcome the problem of spatial locality, a center-of-mass method is used to find the most probable location of the spot for each neutron interaction, potentially allowing to increase spatial resolution and efficiency of the method.

Here we present a parametric study for event-based imaging to computationally obtain optimal parameters, such as the impact of noise, the size of the light spot, the deviations in the center-of-mass methodology and so on through simulations. This is done by random probabilistic sampling of pixels in a grayscale input image simulating the particle interaction and applying a Gaussian blur patch to the sampled pixel value with a kernel size to replicate the problem of low spatial resolution in the simulation. Furthermore, we present the initial results of data acquired using an event-based detector system with each event processed by the proposed methodology.

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