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Pulsed-Neutron Imaging by a High-Speed Camera and Center-of-Gravity Processing

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Pulsed neutron transmission spectroscopic radiography is attractive technique in the research fields of energy-resolved neutron radiography. The imaging technique is based on the energy-analysis of neutrons by time-of-flight (TOF) method. RIKEN RANS (RIKEN Accelerator-driven compact Neutron Source) produces 7 MeV proton beam and Be target pulsed neutron source. The beam current is about 5 μA, the pulse width is 80 μs and the pulse repetition rate is 100 Hz. Our imaging system consists of a neutron image intensifier, a photo image intensifier and a CMOS high-speed camera. The time-resolved neutron imaging is realized by taking continuous images from the accelerator trigger signal and integrating those images with the same sequence. This conventional imaging system has two problems. The first one is small number of pixels as the priority is given to frame speed. The second one is the degradation of spatial resolution caused by the photo image intensifier.

To overcome these problems the center-of-gravity processing was introduced. Picked up images taken by the high-speed camera have many bright spots caused by neutron reaction at the scintillator. Each center-of-gravity of these bright spots was calculate and accumulated on an image map on a memory. By processing center-of gravity of neutron signal the problem of the degradation of spatial resolution has been solved. In the binary dividing calculation to derive the center-of-gravity if the address is derived to two decimal places, the address map can be increased to four times. This means the spatial resolution can be improved and the second problem has been solved.

The accuracy of these processing was measured using simulated pulsed LED bright spot signals and effectiveness of this technique has been showed and applied to the pulsed neutron imaging at RIKEN RANS.

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