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Reconstruction of Energy Integrating by Photon Counting for High Dynamic Range X-ray Imaging

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Photon counting, which measures the energy information of X-ray photons, is an advanced imaging technique in X-ray imaging. One of the merits compared with the conventional energy integrating detectors is the high sensitivity for detecting individual X-ray photons. On the other hand, the range of detectable doses is limited by the pile-up effect in which the detection of multiple photons overlaps. Energy integrating detectors convert the X-ray dose into electric current and measures it, so contrary to photon counting, the dose can be measured without being affected by the pile-up effect even at high doses, while the current generated by the X-ray is buried in the dark current of the detector under low dose. Therefore, we propose an imaging method that is sensitive to individual X-ray photons but is not affected by the pile-up effect by reconstructing the energy integrating based on the photon counting detector.
There are two important points in this proposal: calculating the energy integrating with photon counting detector and implementing it in a CMOS circuit. The calculation method has been expressed using a weighting function for the energy of each photon. By transforming the weight function for energy integrating, the arithmetic circuit can be adjusted. On the CMOS circuit side, in order to measure from individual photons to current, a Pulse Width Modulator (PWM) that easily increase the dynamic range for electric charge has been used. As the result, a pixel circuit for energy integrating without adder circuit has been realized.

Topics

Session C. Applied optics and engineering

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