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Practical expressions describing detective quantum efficiency in flat-panel detector

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Due to the health risks associated with exposure to radiation, technical excellence in medical imaging is critical to high-quality medical care. In radiology, image quality excellence is a balance between system performance and patient radiation dose, hence x-ray systems must be designed to ensure the maximum image quality is obtained for the lowest consistent dose. The concept of detective quantum efficiency (DQE) is widely used to quantify, understand, measure, and predict the performance of x-ray detectors and imaging systems. Cascaded linear-systems theory can be used to estimate DQE based on the system design parameters and this theoretical DQE can be utilized for determining the impact of various physical processes, such as secondary quantum sinks, noise aliasing, reabsorption noise, and others. However, the prediction of DQE usually requires tremendous efforts to determine each parameter consisting of the cascaded linear-systems model. In this study, simple, practical DQE formalisms assessing photoconductor- and scintillator-based flat-panel detectors under typical operation conditions, such as quantum-limited operation, are described. The developed formalisms are validated by comparing the measured DQE values and discussed for their limits. This study will be very useful for the rapid prediction of the DQE performances of developing systems as well as the optimal design of systems.

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