Combination of Photon-Integrating/Counting Detector Moduli for Spectral CT

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Technology description

X-ray detection technology can be categorized into two groups: energy-integration and photon-counting. Almost exclusively, all current x-ray scanners use energy-integrating detectors where electrical signals, from interactions between an x-ray beam and materials, are accumulated over an entire spectrum. In contrast, photon-counting detectors recognize photons both individually and spectrally. The advantages of photon-counting detectors are evident relative to energy-integrating detectors. First, photon-counting detectors record spectral responses of materials that are invisible to energy-integrating detectors. In energy-integrating detectors, low-energy photons carry more contrast information but receive lower weights due to beam hardening. Photon-counting detectors should not have any such bias in weighing x-ray photons. Second, photon-counting detectors have an inherently higher signal-to-noise ratio (SNR) by utilizing spectral information, suppressing electronic and Swank noise and rejecting scattered photons. The SNR improvement for photon-counting detectors can be up to 90%. Third and most importantly, photon-counting detectors can reveal elemental composition of materials and support novel contrast-enhanced studies and opening new possibilities for functional, cellular and molecular imaging with novel contrast agents such as gold nano-particles. CT technology from photon integration to spectrally-resolved photon-counting has high potential to be another breakthrough since Hounsfield's pioneering work on CT. Aided by novel contrast agents such as gold nano-particles, the future of CT will be truly bright and colorful for anatomical, functional, cellular and molecular imaging, leading to major healthcare benefits for diagnosis and treatment of cancers, cardiovascular diseases, and other pathologies.

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