Photon-integrating/counting Detector Combination

VTIP 13-013: "Combination of Photon-Integrating/Counting Detector Moduli for Spectral CT"

U.S. Patent 9,861,324

THE CHALLENGE

Spectral computed tomography (CT) systems are a critical diagnostic tool in medicine. CT machines use computerized x-ray imaging to produce cross-sectional images of the body. Improvements in CT imaging technologies can lower radiation exposure and support life-saving interventions. Current spectral systems can be expensive to implement and may provide only nominal information about an object's material composition and color.

OUR SOLUTION

Ge Wang developed a combination detector that uses both photon integration and photon counting techniques to optimize Spectral CT to minimize patient radiation exposure while creating optimized imagery. The concept uses photon-counting elements to count photons within a window and outside a dynamically-changing window defined by thresholds during a scanning process.

A broad U.S. Patent has been issued on the technology as noted in the exemplary Claim 1 below:

1. An energy-sensitive or spectral computed tomography system comprising:
   an X-ray source configured to emit X-ray beams at an object;
   one or more detectors configured to receive attenuated beams of the X-rays from an object for measuring projection data to generate spectral images in terms of energy-dependent linear attenuation coefficients; and
   said one or more detectors comprising one or more energy-integrating detector elements and one or more photon counting detector elements in one or more detector arrays; and
   at least one of said photon counting elements count the photons within a window and out of a window, and said window defined by one or more dynamically changeable thresholds to capture spectral information in one or more dynamically changeable windows, said windows defined by said thresholds during a scanning process.
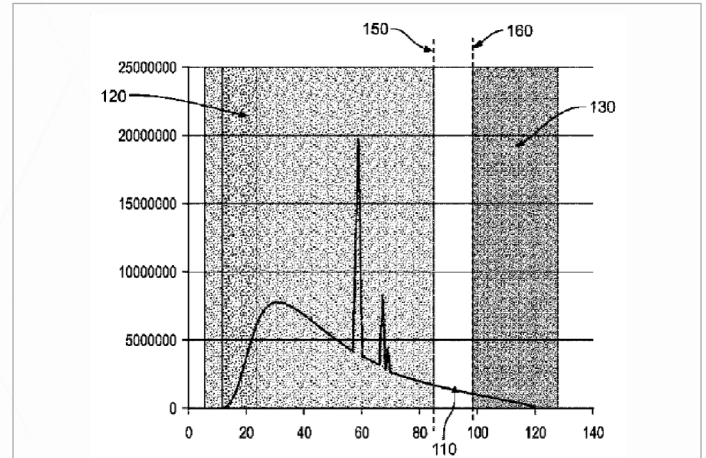
A graph of photon counting process inside and outside dynamically-changing windows (110, 120, and 130).
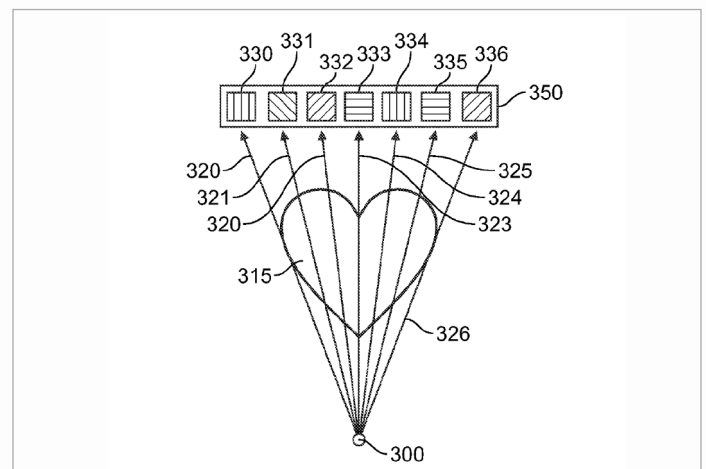
"Counting photons in a window and out of a window generates projection data. The window can be changed randomly during scanning, and different detectors may have different windows in different angles. Each position of the window is an energy channel. This results in the creation of a complex system matrix. Utilizing the relationship among different energy channels, it is possible to reconstruct images in high quality." - Ge Wang

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