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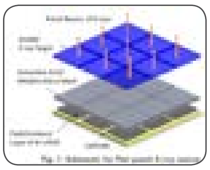
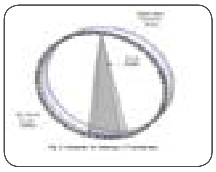
Advances in diagnostic X-ray sources

X-ray imaging has been a prominent part of diagnostics since it was discovered by Rontgen in 1895. For the past 120 years, the X-ray source technology has undergone noteworthy advancements that resulted in a wide range of X-ray imaging modalities for diagnosing various ailments in human anatomy. With the contribution of researchers from all over the globe, the X-ray source technology has been continually advanced to overcome the technical challenges behind applying the X-ray imaging technology to various imaging modalities. In this talk, the advances in diagnostic X-ray sources and their applications that have already being implemented in medical practice and that have a potential to make it to medical practice in the near future will be discussed. It will start with a brief history of X-ray sources along with major leaps in technology that overcame challenges such as dissipating large amount of heat from the anode, maintaining vacuum pressure in the tube, extending the tungsten filament lifetime, and avoiding high-voltage breakdown. Other technical challenges and issues of certain X-ray imaging systems, for example, cardiac CT, duel-energy (spectral) CT, etc. will be discussed. Recent research activities in X-ray tube technology such as utilization of field emission electron source in place of filament, transmission type anodes, distributed X-ray sources, and flat-panel X-ray sources will be introduced. In addition, advanced diagnostic imaging systems such as stationary CT and tetrahedron beam CT based on advanced architecture of X-ray tubes will be introduced. The stationary CT system implements a stationary gantry with X-ray sources and detectors distributed along the gantry to electronically sweep an X-ray beam along the gantry which is expected to reach a temporal resolution of ~30 msec. Finally, non bremsstrahlung X-ray sources that may be useful for medical imaging in the future will be introduced.





Recent Publications

1. Bingham A and Lee H K (2018) The viability of ADVANTG deterministic method for synthetic radiography generation. Comput. Phys. Commun. 228:5-10.
2. Posada C M et al. (2012) Simulation of the electron field emission characteristics of a flat panel X-ray source. J. Vac. Sci. Technol. B. 30(2):2201.
3. Grant E et al. (2012) A Monte Carlo simulation study of a flat-panel X-ray source. Appl. Radiat. Isot. 70(8):1658-16.

Biography

Hyoung K Lee is an Associate Professor and Chair of Nuclear Engineering at Missouri University of Science and Technology (USA). He has his expertise in radiation detection and imaging. He has worked in teaching hospitals as a Medical Physicist and has also been a Faculty Member in academia since receiving his PhD from the University of California at Berkeley. His research area includes radiation detector design and characterization, advanced radiation sources, advanced imaging systems using X-ray, gamma ray or neutron, algorithms for CT reconstruction, image processing, image analysis, and application of deep learning for medical imaging. He has successfully conducted many research projects that covered a wide spectrum of radiation detection and imaging technologies, from development of radiation detectors to development of image enhancement algorithms (some of which were transferred to industry). His current research includes development of flat-panel X-ray sources, compact X-ray tubes for stationary cardiac CT and switchable radioisotopes for imaging and other applications. He has published more than 140 peer-reviewed publications and edited a book chapter in his field of research. He has also given twenty-five invited lectures and one-hundred and nine abstracted talks.

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