

형광체 결합형 X선 영상검출기의 공간 해상력 몬테카를로 시뮬레이션

강상식, 김소영, 신정욱¹, 허승욱¹, 김재형², 남상희

인제대학교 방사선영상연구실, ¹인제대학교 의료영상과학대학원, ²인제대학교 컴퓨터응용학부

Optical Monte Carlo Simulation on Spatial Resolution of Phosphor Coupled X-ray Imaging Detector

Sang-sik Kang, So-yeong Kim, Jung-wook Shin¹, Sung-wook Heo¹, Jae-hyung Kim², and Sang-hee Nam

Radiation Image Lab. in Inje Univ., ¹Dept. of Medical Imaging & Science in Inje Univ.,

²School of Computer Aided Science in Inje Univ.

Abstract : Large area matrix-addressed image detectors are a recent technology for x-ray imaging with medical diagnostic and other applications. The imaging properties of x-ray pixel detectors depend on the quantum efficiency of x-rays, the generated signal of each x-ray photon and the distribution of the generated signal between pixels. In a phosphor coated detector the light signal is generated by electrons captured in the phosphor screen. In our study we simulated the lateral spread distributions for phosphor coupled detector by Monte Carlo simulations. Most simulations of such detectors simplify the setup by only taking the conversion layer into account neglecting behind. The Monte Carlo code MCNPX has been used to simulate the complete interaction and subsequent charge transport of x-ray radiation. This has allowed the analysis of charge sharing between pixel elements as an important limited factor of digital x-ray imaging system. The parameters are determined by lateral distribution of x-ray photons and x-ray induced electrons. The primary purpose of this study was to develop a design tool for the evaluation of geometry factor in the phosphor coupled optical imaging detector. In order to evaluate the spatial resolution for different phosphor material, phosphor geometry we have developed a simulation code. The developed code calculates the energy absorption and spatial distribution based on both the signal from the scintillating layer and the signal from direct detection of x-ray in the detector. We show that internal scattering contributes to the so-called spatial resolution drop of the image detector. Results from the simulation of spatial distribution in a phosphor pixel detector are presented. The spatial resolution can be increased by optimizing pixel size and phosphor thickness.

Key Words : Phosphor, X-ray Detector, Motecarlo simulation, Spatial resolution