



Contribution ID: 146

Type: poster

Investigation of the effect of the scintillator material on the overall X-ray detection system performance by application of analytical models

Tuesday 9 May 2006 14:00 (1 hour)

Computer simulation modeling has been proved as a reliable and promising technique for the evaluation of the performance of medical imaging systems. The purpose of the present work was to model modern X-ray detection system and to investigate the effect of scintillator material on the detector's output signal and the image quality. The scintillators were used in the form of screens (layers) of various thicknesses and the parameters investigated were the Modulation Transfer Function (MTF), the Detective Quantum Efficiency (DQE) and the Energy Absorption Efficiency (E.A.E.). The results of some commonly used scintillator detectors (YAG:Ce, YO₃, ZnSCdS, Lu₃Al₅O₃, CdWO₄, LuO₃) are presented. A computer algorithm, based on commercially available software, was developed to simulate the irradiation process. Typical radiographic conditions including the beam quality, in terms of the X-ray spectrum and exposure, were considered as input parameters (X-ray photons spectrum from 30keV to 140keV). For simulation purposes the intrinsic conversion efficiency (η_c), the total number of optical photons produced per incident X-ray (m_0), the attenuation coefficients and other optical parameters of the scintillator materials under study, were taken as input data. The complete simulation procedure was performed in a specially designed user-friendly Graphical User Interface (GUI). The results showed that, under typical examination conditions (80kV, 1mAs and 80 mg cm² coating thickness), the MTF and DQE curves were affected by the X-ray energy absorption efficiency and the intrinsic properties of the scintillator materials. The Lu₃Al₅O₇ scintillator presented similar behavior to that of ZnSCdS:Ag, exhibiting similar DQE at zero spatial frequency (0.16) and MTF at 200 lp (0.15). The YAG:Ce scintillator exhibited higher MTF at 200 lp (0.2) compared to the one of the YO₃:Eu scintillator (0.1), but lower DQE at zero spatial frequency (0.062).

Author: Mr EFTHIMIOU, Nikolaos (Department of medical instrumentation-Technological educational institution)

Co-authors: Mr KONSTANTINIDIS, Anastasios (Department of Medical Physics, School of Medicine, university of Patras, Patra, Greece); Mr MICHAIL, Christos (Department of Medical Physics, School of Medicine, university of Patras, Patra, Greece); Dr NIKOLOPOULOS, Dimitrios (Department of Medical Instrumentation, Technological Educational Institution of Athens, 12210 Egaleo, Greece); Prof. CAVOURAS, Dionysios (Department of Medical Instrumentation, Technological Educational Institution of Athens, 12210 Egaleo, Greece); Dr LOUDOS, George (Department of Electrical and Computer Engineering, National Technical University of Greece); Prof. PANAYIOTAKIS, George (Department of Medical Physics, School of Medicine, university of Patras, Patra, Greece); Mr PATATOUKAS,

George (Department of Medical Physics, School of Medicine, university of Patras, Patra, Greece); Mr GAITANIS, Ioannis (Department of Medical Instrumentation, Technological Educational Institution of Athens, 12210 Egaleo, Greece); Prof. KANDARAKIS, Ioannis (Department of Medical Instrumentation, Technological Educational Institution of Athens, 12210 Egaleo, Greece); Mr VALAIS, Ioannis (Department of Medical Instrumentation, Technological Educational Institution of Athens, 12210 Egaleo, Greece); Prof. KOURKOUTAS, Kostantinos (Department of Physics, Chemistry and Materials Technology, Technological Educational Institution, 12210 Egaleo, Greece); Dr KALIBAS, Nektarios (Greek Atomic Energy Commission, 153 10, Ag. Paraskevi P.O BOX 60092, Greece); Mr DAVID, Stratos (Department of Medical Physics, School of Medicine, university of Patras, Patra, Greece)

Presenter: Mr EFTHIMIOU, Nikolaos (Department of medical instrumentation-Technological educational institution)

Session Classification: Poster Session :Simulation, Modeling, Reconstruction

Track Classification: • System simulation, design and implementation