AbstractID: 3446 Title: A Diagnostic X-ray Simulator for Out-Patient-Department Examinations

Purpose:
To develop a diagnostic X-ray image simulator for commonly used out-patient-department examinations including lower extremities, skull, abdomen, pelvis, chest, and spinal cord. This simulator can be used as a computer-assistant-teaching software for training technologists more familiar with the relationship between image quality and operation conditions.

Method and Materials:
A detailed simulation of a diagnostic X-ray image requires four major inputs: operation conditions, X-ray spectral and spatial distributions, a human model, and cross-section corresponding to different materials. This study has collected commonly used operation conditions such as kVp, mAs, SSD for different OPD examinations. These conditions have been inputted to a Monte Carlo code, BEAMnrc, to build a virtual X-ray machine for calculating X-ray spectral and spatial distributions. After that, a high resolution voxelized human model, VIP-Man constructed from segmented Visible Male Dataset, will be imaged with this virtual X-ray machine. The cross-sections of different materials are generated by PEGS4, a cross-section preparation tool come with EGS4.

Results:
X-ray spectra simulated using BEAMnrc is almost identical to those listed in literatures, or from a spectra simulator, XCOMP3; except there is about 30% underestimation in characteristic peaks. However, this underestimation will lead to less than 0.1% deviation in our simulation. Heel effects can be observed in our simulated images. The intensity response was calibrated to a real digital X-ray machine, and point spread functions of this machine are measured to degrade our simulated images.

Conclusion:
We have developed this X-ray image simulator which can benefit the training of technologists. This simulator can be further improved to serve as a platform for studying image quality parameters such as QDE or MTF after we adding more realistic model of image receptor.

Conflict of Interest (only if applicable):