Abstract ID: 16038 Title: Designing Simulators for Studying Medical Physics: From CT Imaging to Radiotherapy Treatment Planning and Quality Assurance

Purpose:
Designing simulators for studying medical physics ranging from CT imaging to radiotherapy treatment planning and quality assurance will be very valuable for students, educators, and medical professionals to learn and teach radiation physics principles and to perform virtual practicing of the patient diagnosis and treatment based on physical principles.

Methods:
A Monte Carlo method is the best to simulate the radiation transport phenomena. Thus, in this project, we used our in-house Monte Carlo code, PMCEPT code, to simulate directly the interactions between the radiation and the patient body. However, for better understanding of the complex physical phenomena involved in the radiation interactions with matter, some augmenting novel computational approaches such as ray-tracing and medical image segmentation algorithms are included. Specifically, fast ray tracing method is useful for better understanding the CT images and the near future IGRT treatment planning. For the real time simulations, parallel algorithms adaptive to PC cluster and GPU-accelerated algorithms were employed.

Results:
The CBCT simulator with a set of ray beams emitting towards every pixel center of the detector from the X-ray source was developed. Semi-automatic segmentation of CT image using watershed algorithm and graphical user interface was developed for analyzing the DICOM data to provide ASCII data file which is readable. The external beam accelerator operated with keyboard and mouse was developed.

Conclusions:
The important benefits of these virtual simulators may be the replacement of the conventional laborious procedures which are required for the expensive hardware simulator units, the efficiency increment, the accuracy improvement of radiation treatment procedure, and the cost reduction in terms of time and physical patient's presence. A more extensive assessment of the efficiency improvement provided by these simulators is still under investigation and will be presented in future articles.

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