AbstractID: 6674 Title: MARS – A Monte Carlo assisted research system for radiotherapy

**Purpose:** To develop a dedicated and versatile research system for radiotherapy treatment planning that combines Monte Carlo dose calculation accuracy with inverse planning capability.

**Method and Materials:** In this work, a research platform with interactive graphics user interface (GUI) has been developed for Monte Carlo based inverse planning for radiotherapy. It consists of a *top-level* module that integrates and coordinates the other four sub-modules in the system: a *DICOM IMAGE/RT server* module that receives all incoming DICOM images and DICOM RT objects, an *iPort* module that constructs a patient phantom in EGS4 format from DICOM image studies, a *phant2optim* module that performs ray-tracing in the phantom and prepares input for pre-optimization Monte Carlo simulations of the beamlets, and an *optim2mcsim* module that optimizes a treatment plan based on Monte Carlo simulated beamlets dose distributions and prepares input for post-optimization Monte Carlo simulations of the plan.

**Results:** A Monte Carlo assisted research system (MARS) with five designed modules has been developed and integrated by an interactive graphics user interface. Interfacing of the MARS with the Varian Eclipse treatment planning system (TPS) via DICOM RT and with the EGS4/BEAM for Monte Carlo dose calculation has been successfully established and verified.

**Conclusions:** A Monte Carlo based inverse planning system has been developed for radiotherapy treatment planning and research. This system is able to import DICOM IMAGE/RT objects from a clinical TPS, convert them into a patient CT phantom, and optimize a plan based on Monte Carlo simulations of beamlet dose distributions in the patient CT phantom. With the dose calculation accuracy of Monte Carlo, multiple inverse planning algorithms, and a user-friendly GUI, we hope this system will further enhance the application and research of Monte Carlo treatment planning in radiotherapy. We plan to have it available free to interested parties in the future.