Orthovoltage radiation therapy planning

CISC 499 Undergraduate Project Proposal

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Purpose and Objectives

Orthovoltage radiation therapy (ORT) is a non-invasive treatment technique commonly targeting superficial tumours, such as those present in non-melanoma skin cancer. Presently, there is no treatment planning system commercially available for ORT. The Cancer Centre of Southeastern Ontario (CCSEO) proposes to use a freely available radiation dose modelling software package: EGSnrc. However, EGSnrc is difficult to use due to its heterogeneous process and command-line interface employing configuration files. 3D Slicer is a widely used open-source medical image analysis and visualization software platform. SlicerRT is an extension for 3D Slicer augmenting it to provide generic radiation therapy functionality, including external radiation beam planning.

The overall objective is to develop a module in SlicerRT that provides a convenient user interface to create the ORT plan, uses 3D Slicer's advanced visualization capabilities, and drives EGSnrc to calculate the patient dose. The resulting application would act as an ORT treatment planning system, not only fully functional, but also free and open-source.

Methods

The EGSnrc software workflow can be used to model the passage of electrons and photons through matter, for example through a CT image, and calculate the resulting dose deposition at each position in the image. This software is difficult to use, since it involves many command line steps and manually creating input files. The first goal is to create an integrated workflow within SlicerRT, which generates the proper input files for the subsequent EGSnrc processing steps (see Fig. 1). The first deliverable is a module within SlicerRT, which drives EGSnrc through an ORT planning workflow with every input fixed. It would be a proof of concept for the complete remote control of EGSnrc within the 3D Slicer ecosystem.

The second objective is to design and implement a user interface (UI), which presents the necessary input in a way that is familiar and convenient to the radiation oncology team. The beam geometries, target dose, and all other input values must then be transferred to EGSnrc via the configuration files that were generated in a static way in the first deliverable. The second deliverable is this UI with the updated, now dynamic interface components between the two platforms.

Future work will involve the translation of this software in the clinic. The resulting treatment planning system prototype will be first tested with the simplest possible plans, then move towards the complexity of the actual clinical plans. Finally, dosimetry needs to be performed on phantoms to compare the dose calculated by the ORT planning system and the actual administered dosage.

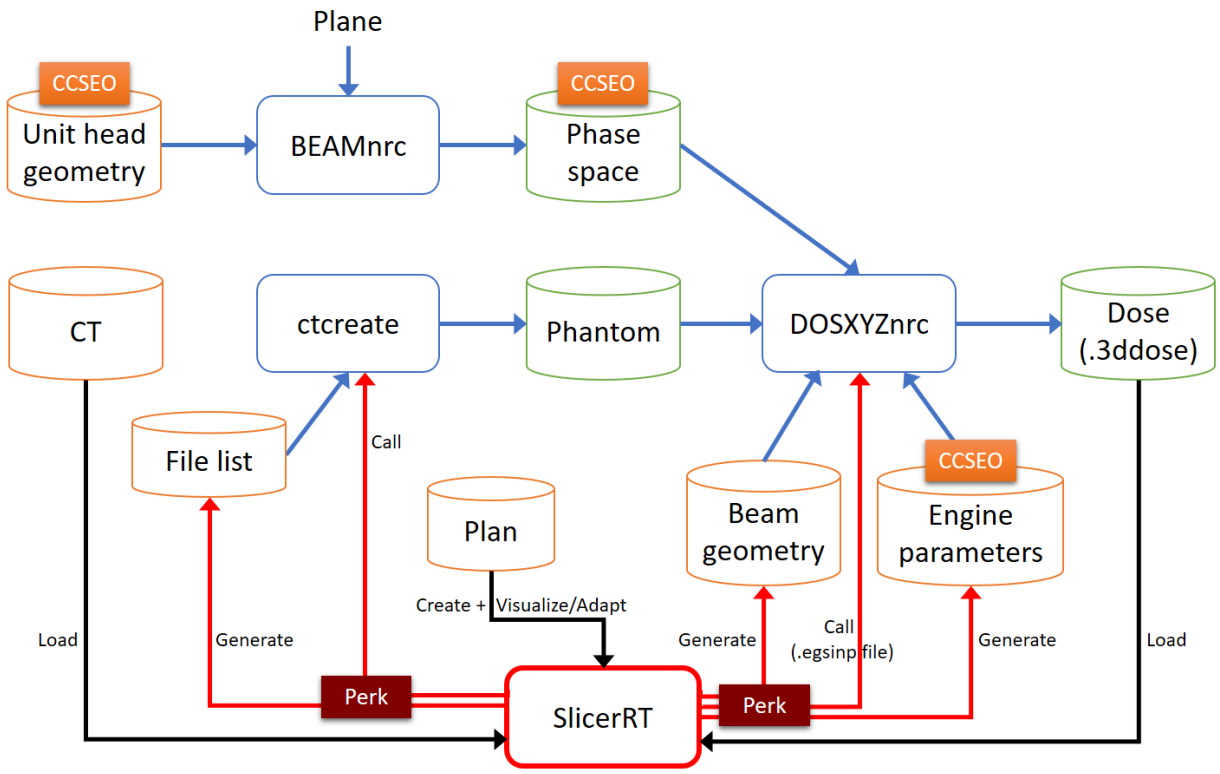

Fig. 1. Data flow diagram of the integration of SlicerRT and EGSnrc. Red arrows show the missing links needed to develop in terms of this project. The boxes with the label 'CCSEO' indicate tasks for the clinical collaborators.