St. Jude Children's Research Hospital®

St. Jude BioHackathon

Title
Proton beam geometry simulation for training, teaching, and optimal treatment geometry determination

Category
GUI Tool Development

Challenge
One of the single biggest predictors for proton radiation therapy dose distributions is the treatment geometry chosen during the pre-treatment planning process. It is therefor critical that the treatment team have maximum flexibility in setting up the treatment plan. A significant challenge in this process is ensuring that chosen setups are allowable by the physical limitations of the machines and accessory devices used in treatment, primarily with collision avoidance in mind. Three-dimensional models and collision avoidance systems have been developed for the more ubiquitous hardware used in the field of radiation oncology, but given the specialized nature and equipment of St. Jude, nothing exists specific to us. We propose to develop a three-dimensional collision avoidance application specific to the St. Jude Red Frog Events Proton Therapy Center. There are three levels of achievement we are aiming for:

1) Identify if a chosen treatment geometry is allowable, uncertain, or not possible with simple text feedback.
2) Allow for three-dimensional navigation of a mock treatment room by moving the three key components to the treatment machine to visually assess the feasibility of different treatment geometries.
3) Gamifying the visual model in step 2 as a tool for patient and caregiver education. This would allow for nursing and Child Life team members to better explain the treatment process in advance of the first treatment and allow for patients to interact with virtual representations of the machine in a fun environment.

Benefit
While the project is focused on a clinical issue, the impact would be felt in the research efforts of the department. A key priority to our department, and something that has featured prominently in the prior and future strategic plans, has been identifying the benefit of proton therapy in the treatment of children. Critical to those efforts are ensuring that we are maximizing the full potential of our system in the treatment of both protocol and non-protocol patients.

Helpful Tools, Packages, or Software
We anticipate using either Unity (preference given the prior experience of some in our department) or Unreal for the visualization and rendering of three key components to our treatment rooms. Clinical team members have volunteered their time for consultation on the product design, testing, and implementation (radiation dosimetrists, therapists, nurses, Child Life, and physicists). We have a handful of members of the department with experience in various coding languages and platforms and would welcome outside help from those with experience in Unity, C#, DICOM standards, CAD, or anything else of potential use.

Test Data
We will use a combination of vendor supplied representations of the treatment devices to be rendered, physical measurements in the treatment room (conducted after hours), and de-identified plan data extracted from our clinical database. Further validation can be performed on the clinical systems after hours to verify faithful representation for various mock and real treatment geometries.