A Patient-Specific Model for a Collision Prediction Script Using an Azure Kinect

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INTRODUCTION

Advancements in external beam radiation therapy allow for minimal dose to healthy tissue while delivering prescription dose to the target.This is possible due to non-coplanar treatment techniques. However, an increased number of moving beams can lead to an increased likelihood of collisions. To avoid this complication, a collision prediction script can be used to anticipate any collisions that may occur during treatment planning. Yet, most collision prediction systems use an inadequate model for the patient such as an incomplete surface of the patient obtained from the external contour generated from the target CT.

AIM

The purpose of this project is to create a method of obtaining a patient-specific full body model that is independent of commercialized software to be incorporated in the clinic's current collision prediction software as a proof of concept.

METHOD

- First a depth image of the patient is obtained using an Azure Kinect DK (Microsoft) [1]. This depth image is then transformed into a three dimensional point cloud.
- The point cloud is then handled in a pythonic script powered by the open source library Open3D [2].
- The scripts allow for cropping, manual registration, and transformation of the point cloud into the coordinate system used by the collision prediction script.
- The project then compares the full body model to previous scenarios in which a collision would not have been detected.

RESULTS

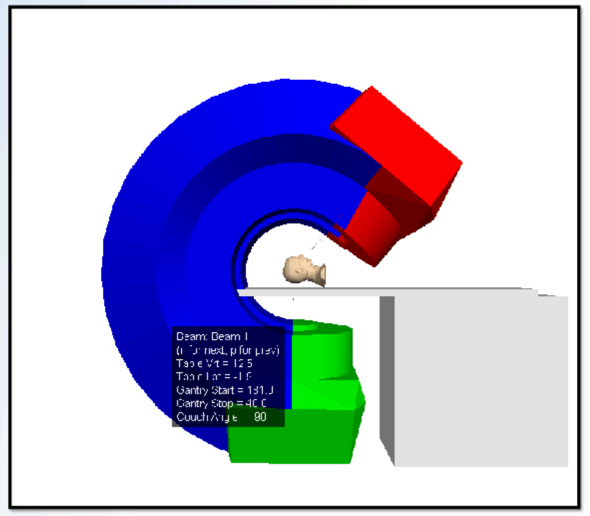

Figure 1a.

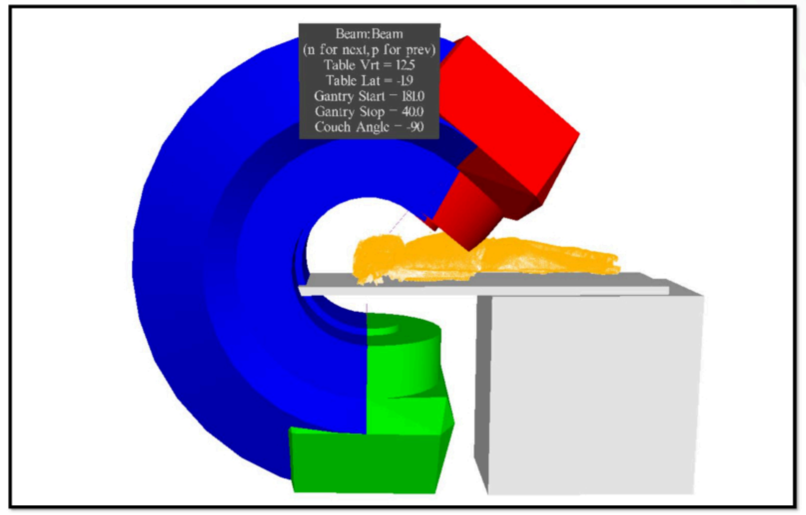

Figure 1b.

Figure 1a and 1b: Figure 1a. shows how the current model for the CPS in which there is uncertainty beyond the model obtained by the target CT. Figure 1b. shows the new model in which a collision is visible in this previous nonvisible area. (In this model, the green represents gantry start position, red represents gantry stop position, and blue represents the path of the gantry.)

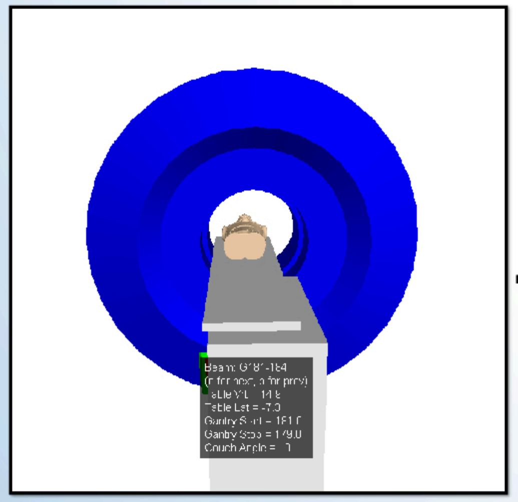

Figure 2a.

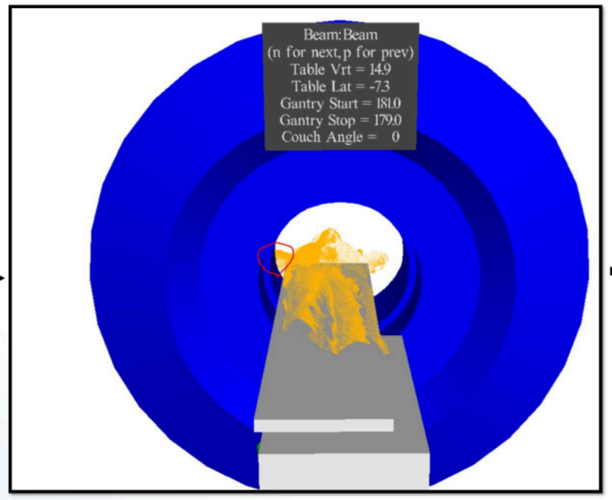

Figure 2b.

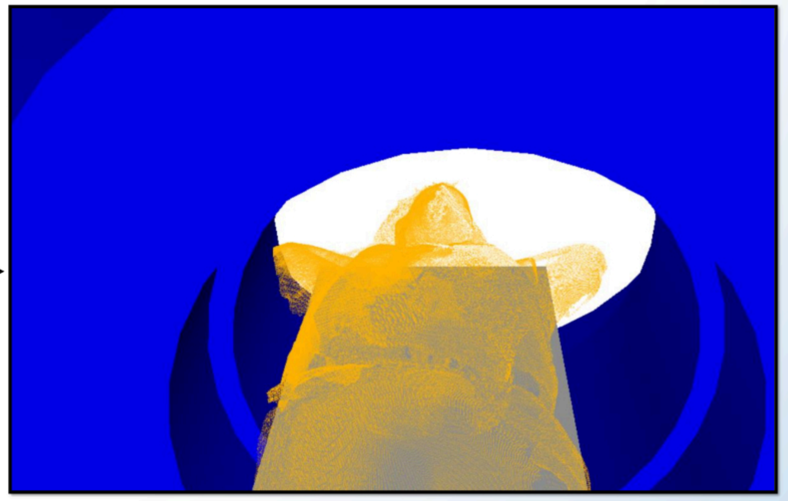

Figure 2c.

Figure 2a, 2b, and 2c: Figure 2a. shows how the current model for the CPS in which there is uncertainty about the location of the elbows. Figure 2b. shows the new model in which there is a collision (circled in red) between the gantry and the patient's right elbow. Figure 2c. Is a closer view of the intersection between the elbow and gantry. (In this model, the green represents gantry start position, red represents gantry stop position, and blue represents the path of the gantry.)

CONCLUSIONS

In this project a patient-specific model independent of any commercialized software was created. This model was created by registering two point clouds obtained from the Azure Kinect DK, and a third registration with the skin contour created from CT Sim data. The point cloud model allows for visualization of parts of the body not included from CT Sim Data. Future work concerning this project will focus on validating the point cloud and creating a water-tight mesh from the point cloud.

REFERENCES

1. Azure Kinect DK – Develop AI Models: Microsoft Azure. (n.d.). Retrieved June 26, 2020, from https://azure.microsoft.com/en-us/services/kinect-dk/
2. Zhou, Q., Park, J., & Koltun, V. (2018). Open3D: A Modern Library for 3D Data Processing. *arXiv:1801.09847.* http://www.open3d.org/wordpress/wp-content/paper.pdf

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