**Collision Check Script – info and model limitations**

**The objects included in the model are:**

Body structure

Patient bounding box (made based of the body structure/contour)

Couch (specifically the couch interior structure. The surface does not work because it is hollow and not a closed surface. This is a bit of a problem because that is smaller than the actual couch)

Prone Breast Board (if it is in the structure set)

The surface of the gantry head (modeled as a disk)

The program works with all couch angles.

The program has safety checks to make sure a structure set is present and that the couch interior and Prone Breast Board structures are contoured before trying to access them, if present.

The program looks for a variety of punctuation and spelling variations to find the structures. It does not look for exact names, it only needs to contain the name. For example the program would identify all of the following as the Prone Breast Board: “NS\_Prone\_Brst\_Board”, “prone\_bst\_brd”, “Prone Brst Brd”.

The program runs the same collision analysis subroutine comparing the gantry disk to the patient bounding box, couch, and the breast board. It does not do the collision analysis with the body structure itself. There is really no need with the bounding box present and this saves time because the collision analysis can be computationally demanding.

The limitation with the couch is it only works with what is contoured. We can add some other things that would be easy to contour (like the Head and Neck immobilization device). If there is a contour, we can add those objects to the model. Adding other objects to the model would slow it down, though only for plans that have these other contours.

If ARC plan (dynamic gantry, dynamic MLC): iterates through the MLC control points to get the gantry angle, checking every 5 deg; shows G angle for 1st potential collision (<= 5 cm clearance) and G angle when clearance becomes > 5 cm; logic useful if multiple areas of collision along the arc (with ev. different objects)

If SW IMRT (static gantry, dynamic MLC) - performs the collision analysis for the gantry angle of the first MLC control point, since all the control points have the same gantry angle

If static MLC beams (Arc or not) - takes G angle info from ECLIPSE database (querying). If it is an arc, the program will make a list of angles, for every 1 degree, between the start and stop angles and then will iterate through and check every 5th angle.

It works for HFS, HFP, FFS, and FFP orientations. The collision script gets the treatment orientation from the plan and if it is HFP or FFP it will make some adjustments to make sure it is handled properly.

Don't need to do anything - the script knows what the orientation is and it will handle it.

When running a static MLC plan where it queries the database, you will need to click "switch to" on the "server busy" pop-up that comes up for every database query it does. When this happens, the Eclipse scripts window will get in the way so you won't be able to see the collision check window when it is done. After the program has finished, and all the beam images have appeared (if there is a collision), the Collision Check GUI should appear in the foreground so you can see it again.

The program also makes corrections if the Isocenter of a plan is not at the same position as the User Origin (because the program was designed assuming they were the same). This happens independent of the orientation corrections.

Summary of Limitations:

* Program can only work with what has been contoured
* The patient bounding box is not designed for a patient laying at an angle (like on some kind of board). In this situation, the bounding box will be larger in the vertical (Y-axis) direction in some parts. This can cause a false collision alert.
* The dimensions of the Bounding Box can vary slightly when it is remeshed (due to choppiness in the triangles that make up the edges). If the gantry is very close to the 5 cm margin, this could cause collisions alerts to be inconsistent between different beams of the same plan, or when the program is run several times on the same plane.
* The overall length of the bounding box (on the Z-axis) might be somewhat inaccurate because it an estimation based off the “body area” of the CT scan selected when the program is run and the height of the patient. Entering the patient’s actual height can help. This is only relevant for plans with couch kicks, so not a huge problem.

***Examples:***

**Reg. Bordonaro's plan**:

She may have been treated without an issue, but I do think what the program is finding/displaying is real. There is no contour showing this, but she was simmed on some kind of board, with her body laying at an angle vertically. Even though the contour for this support structure isn't there, the geometry with respect to the patient's body and the couch is the same compared to what is displayed in Eclipse and what the collision check program displays. On the two 303 degree gantry angle beams, the collision check finds that the gantry is clipping through the upper corner of the bounding box, which makes sense considering the patient is lifted off of the couch and the Iso is high vertically. The problem here with how the program works is that the bounding box can't account for the patient laying at an angle. The vertical position of the bounding box is based off of the centroid of the body structure, which in this case is going to be lifted off of the couch vertically, but there is more clearance in real life because she is laying at an angle. No easy fix for this – **false positive**