

Integrating clearance mapping with MapRT into clinical practice

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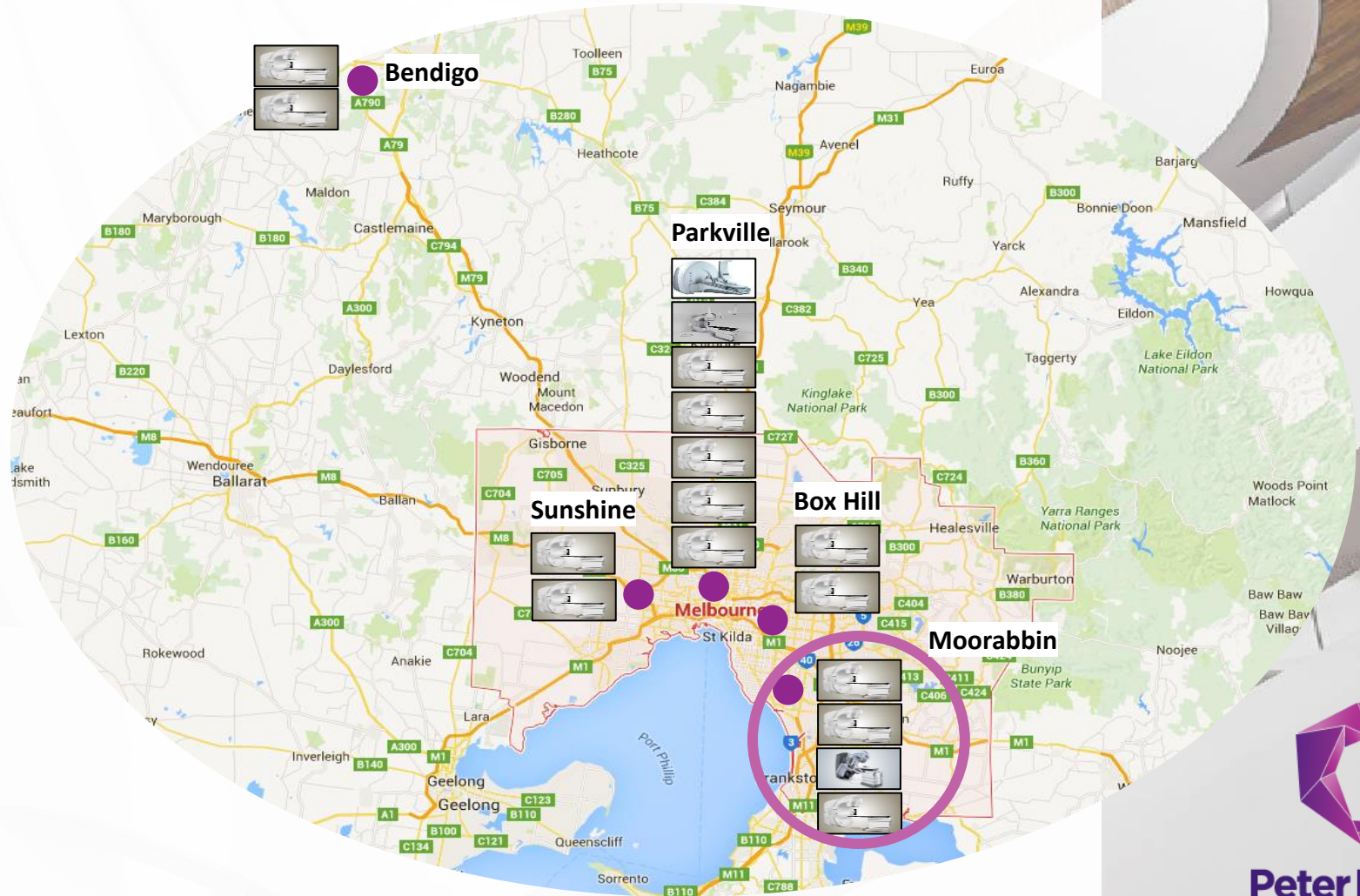


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5 Petermac Sites:

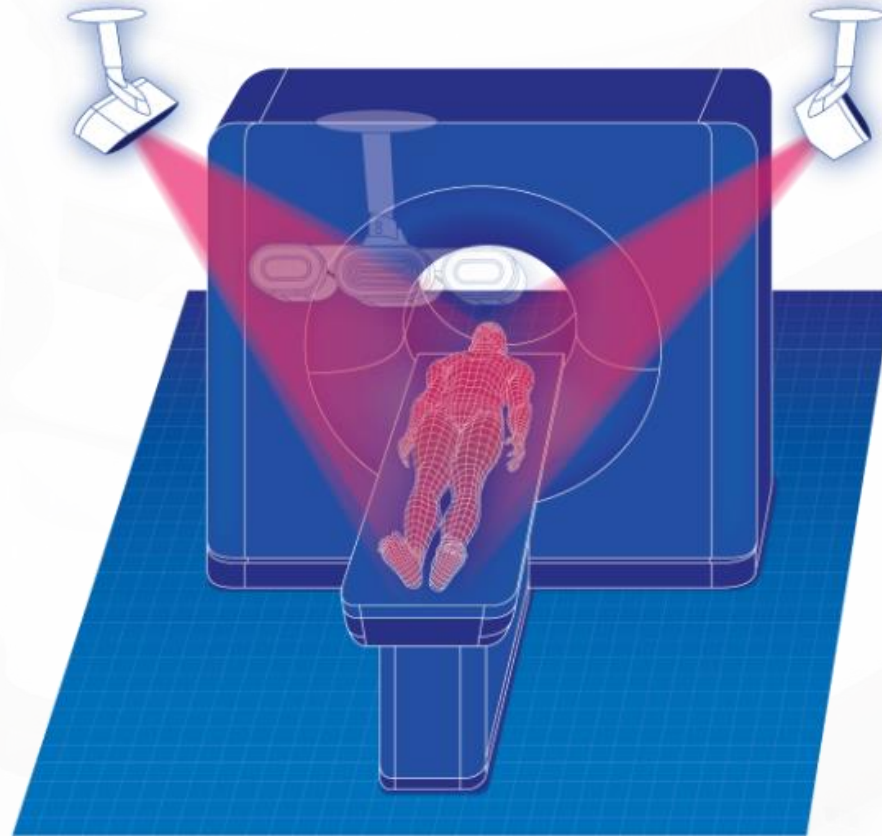
- 16 Varian linacs
- 11 Vision RT AlignRT Advance
- 3 Gen 5 HD cameras
- 8 Horizon cameras
- 1 Elekta Gammaknife
- Elekta brachytherapy
- Varian Eclipse
- Brainlab Elements
- Elekta Leksell GammaPlan
- Elekta MOSAIQ ROIS
- 6 Phillips CT
- 1 Siemens CT
- 1 Vision RT MapRT



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What is MapRT?

- 2 x Horizon Full field of view cameras
- 2 x dedicated MapRT computers
- Capture 3D surface of entire patient + accessories



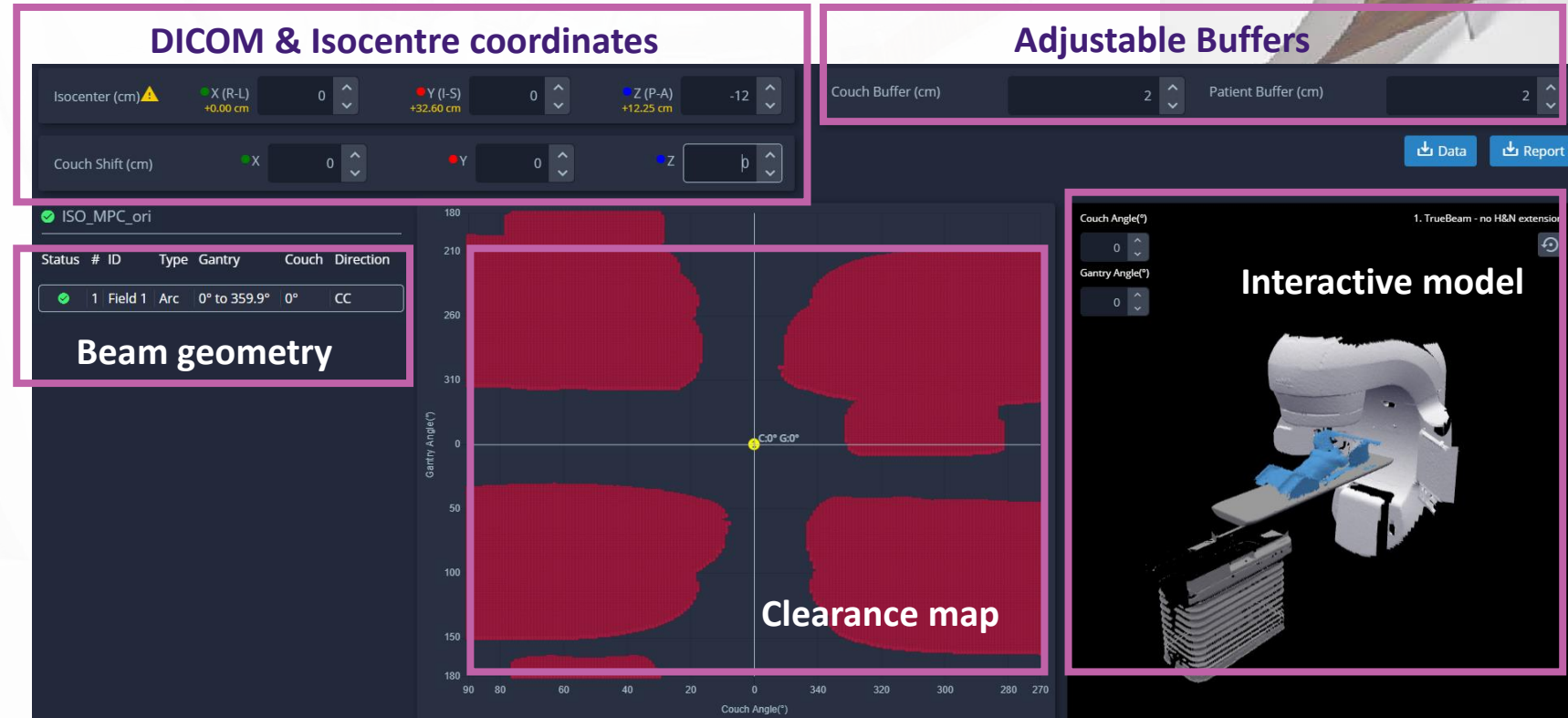
MapRT image courtesy of VisionRT



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What is MapRT?

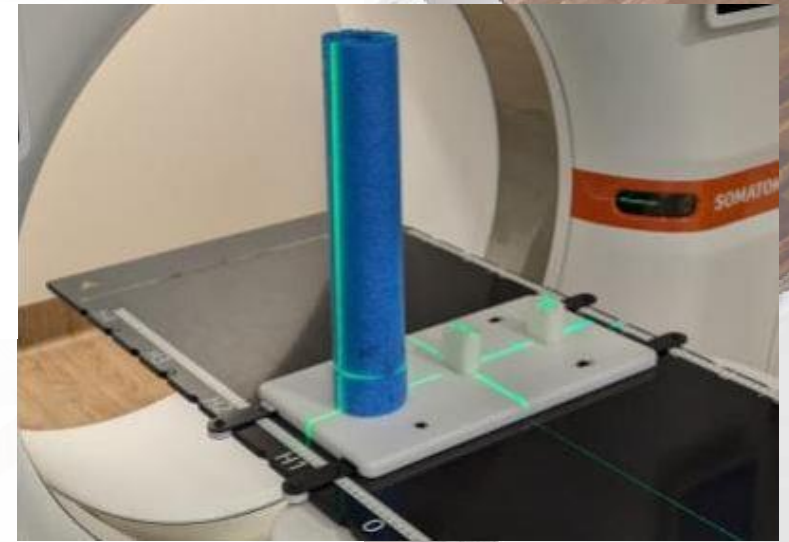
- View clearance map in online browser
 - Interactive interface
- Patient position, plan isocentre, linac, imaging arms, couch



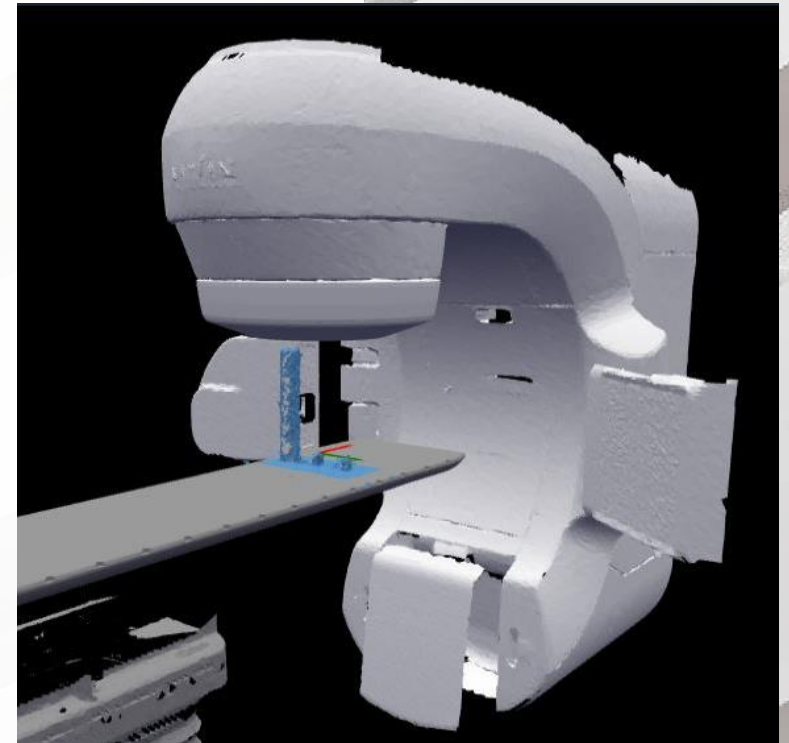
MapRT Clearance browser with an exported plan

Commissioning

- **Installed** on 20th May 2024
- **Physics commissioning tested:**
 - Accuracy and Reproducibility of MapRT scans
 - Trigger points of both machine and patient interlocks to verify what “buffer value” is safe.
- Most measured collisions agreed with MapRT within **2 degrees**



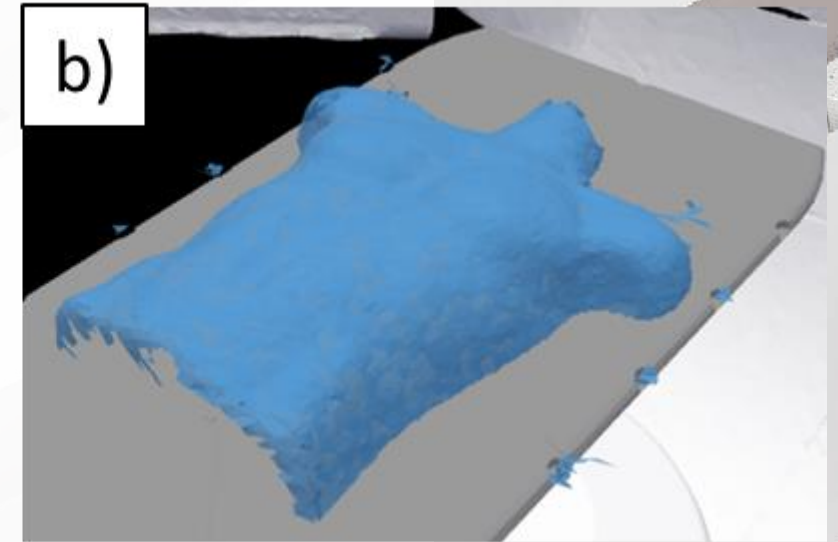
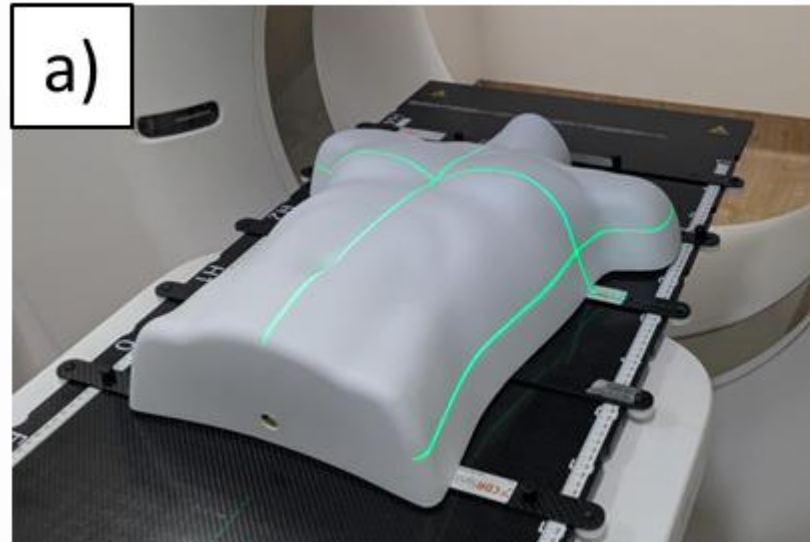
Physics QA Phantom for MapRT



Commissioning

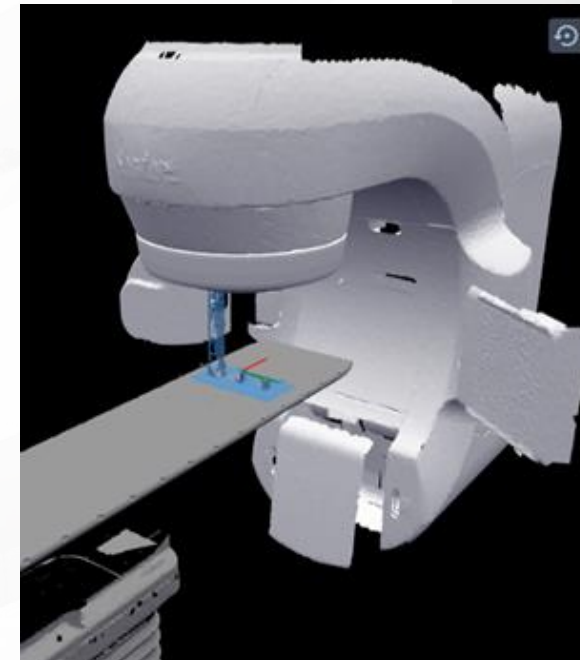


- **Accuracy and Reproducibility**
- Mannequin scanned by MapRT three subsequent times.
- Lockbars placed on the CT couch to verify accuracy of the mannequin placement on the virtual couch.



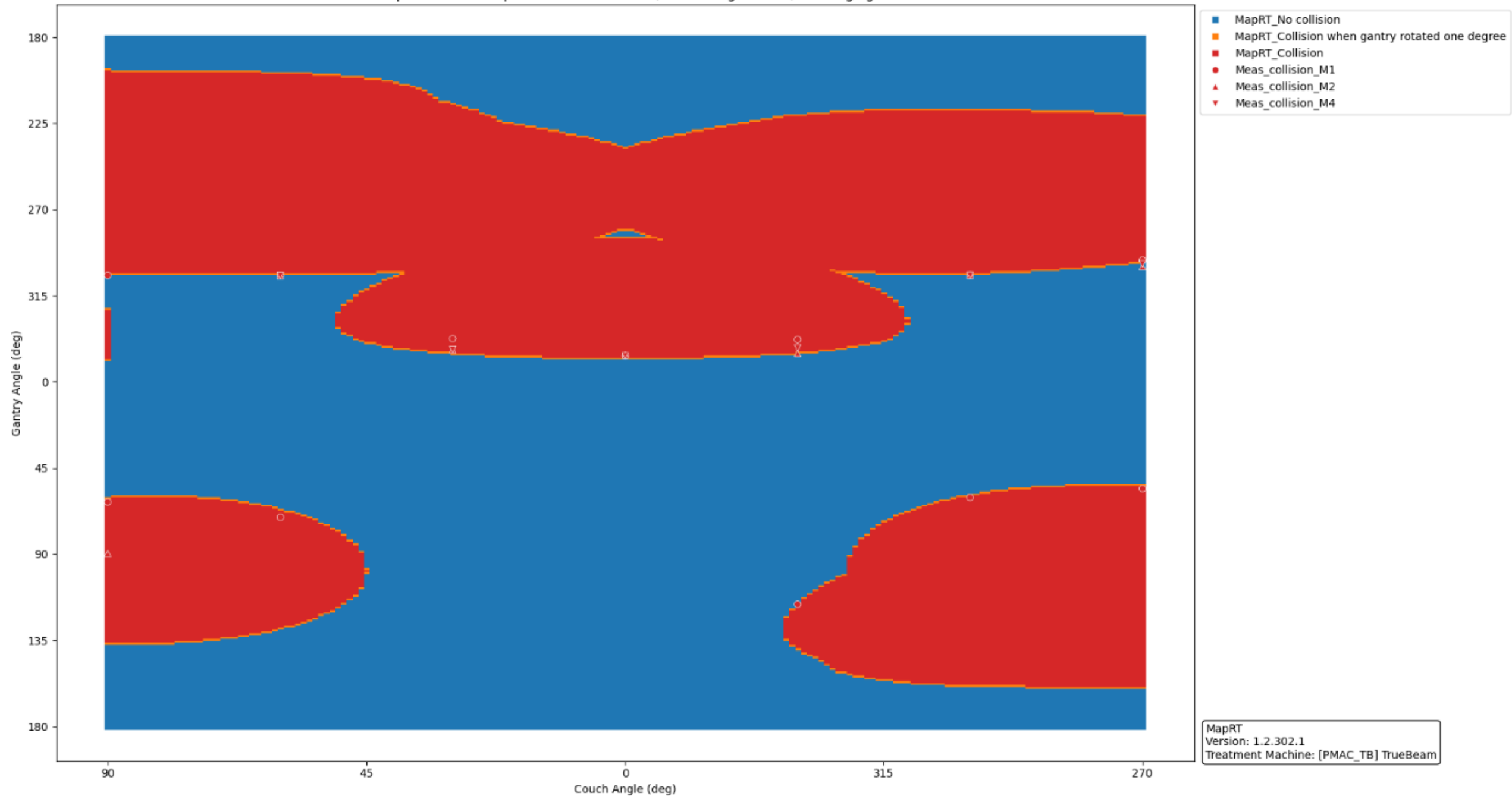
Commissioning

- **Collision map verification**
- Our **Potential Overlap On Linac (POOL)** phantom was scanned by MapRT.
- A variety of treatment geometries were mocked up and a sample of collision points on our clinical machines were measured.
- This was also completed for different machine configurations (KV panels, electron applicators etc).



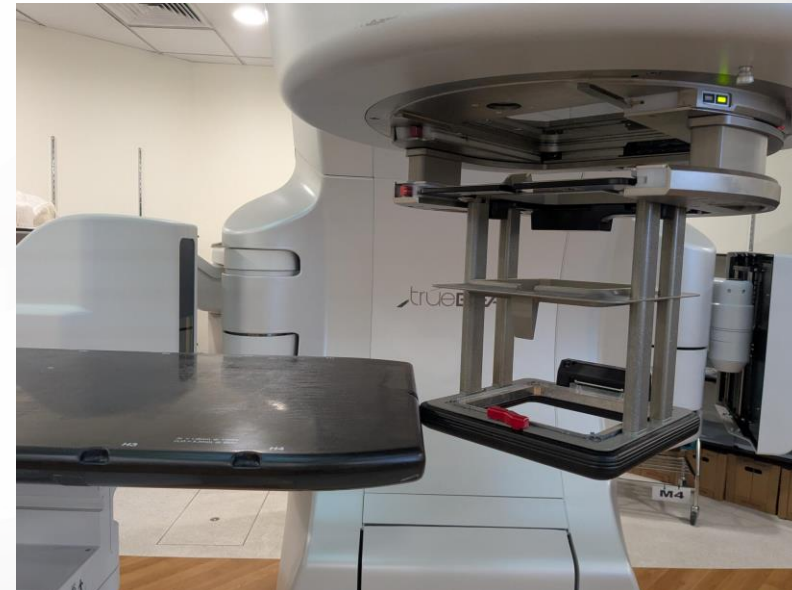
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MapRT Collision Map - Vertical Pool Noodle, Patient Right 15cm, No imaging



Commissioning

- **Collision map verification**
- Most measured collisions agreed with MapRT within **1 degree**
- We found in the cases where they did not agree, MapRT would falsely flag collisions, instead of not detecting them.
- We recommended using a buffer value of 2cm to consider patient motion, setup variation, and machine to machine variability.



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Staff Training



Vendor training

- 1 day training
- CT & Education staff

Initial staff training

- Rollout of training to all planning staff
- Competency checklist

Ongoing staff training

- Upskilling of new staff rotating into planning as needed

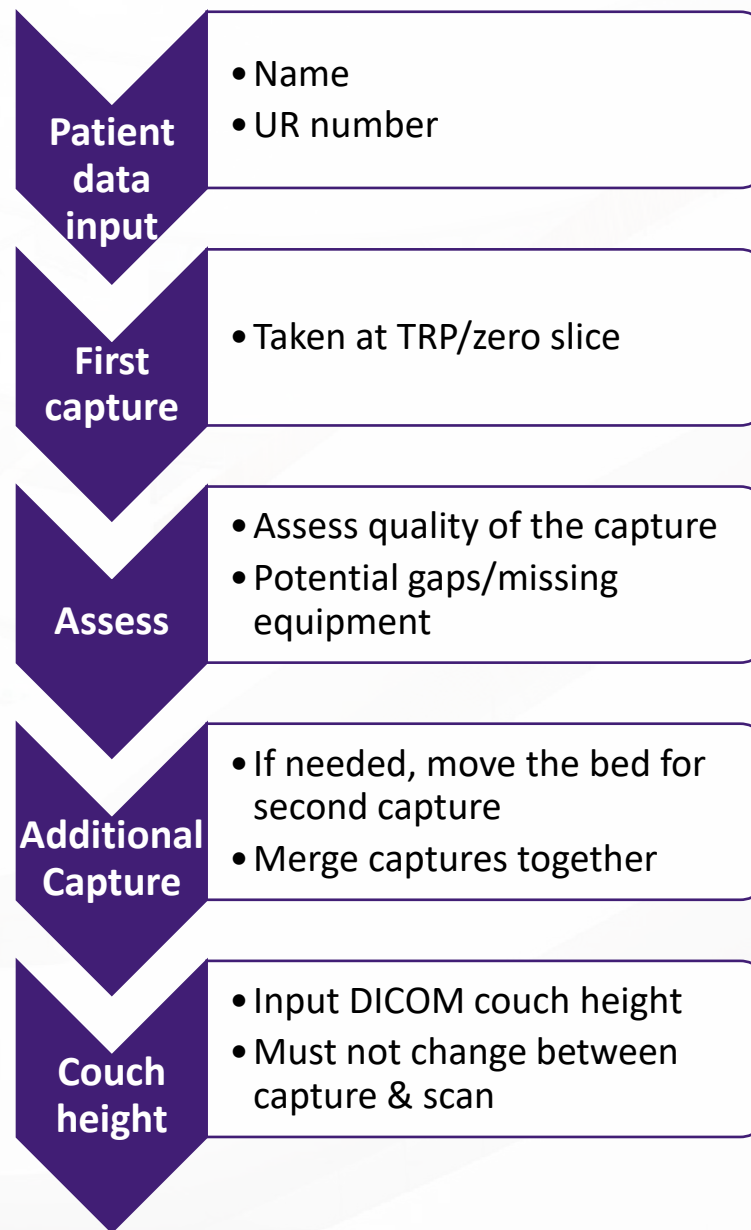
MapRT utilization

- Assessed how MapRT was being used by the staff



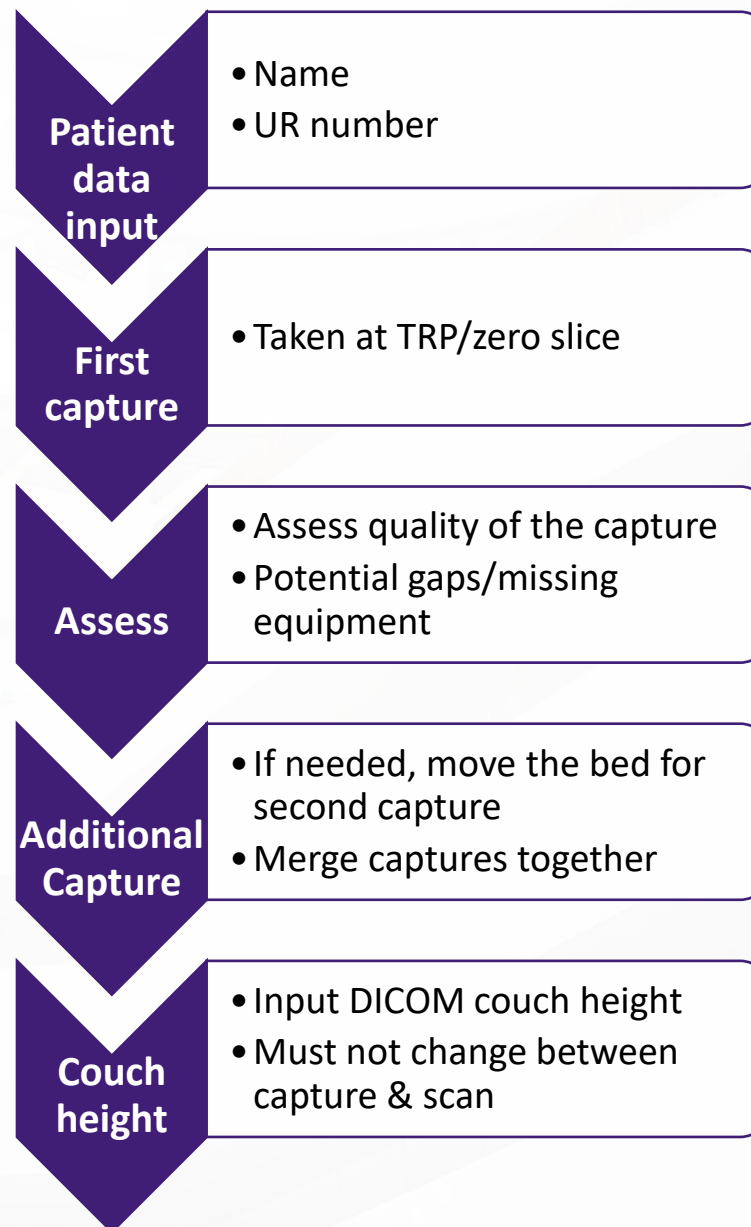
Workflow

- Capture before or after CT scan
 - Suggested to capture prior to scanning



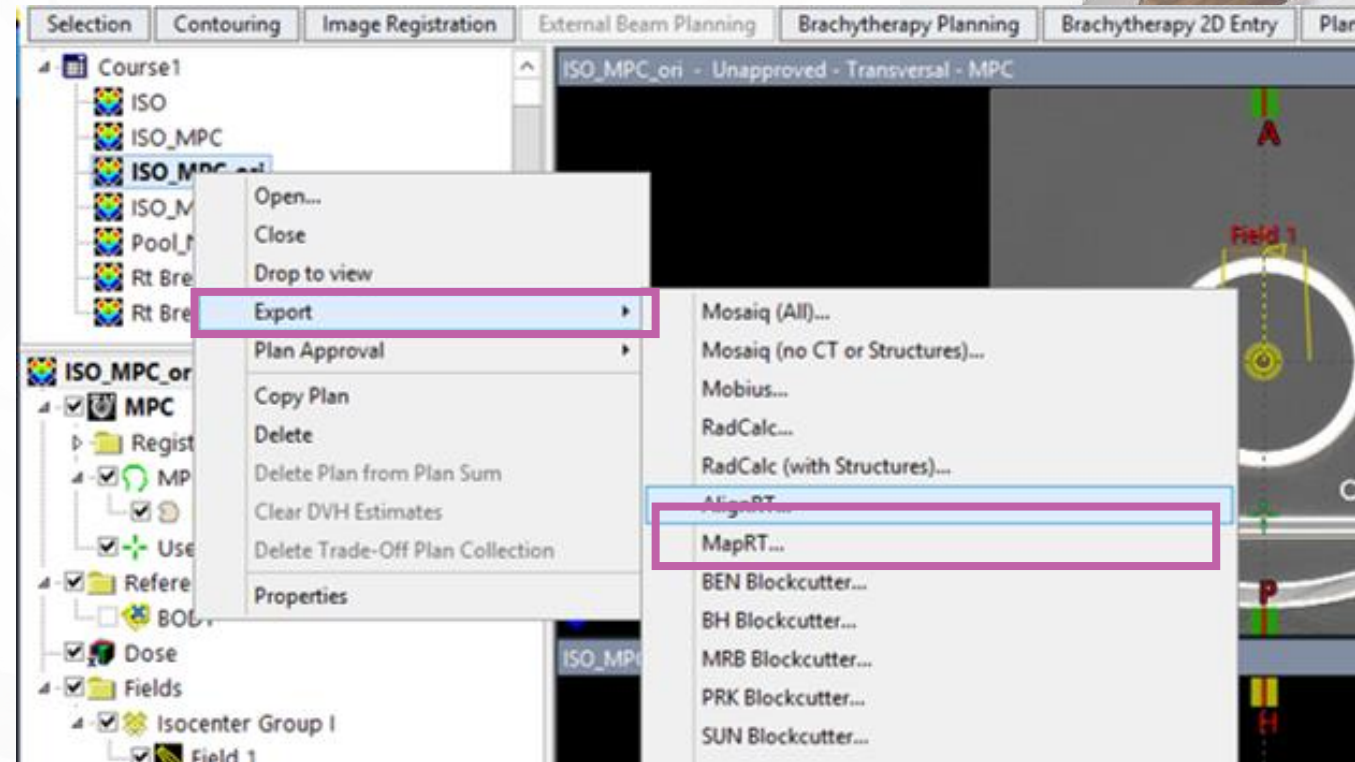
Workflow

- Capture before or after CT scan
 - Suggested to capture prior to scanning
- Re-open the surface capture in MapRT to assess iso placement and clearance at CT
 - Can adjust the patients position prior to scanning if needed



Workflow

- Capture before or after CT scan
 - Suggested to capture prior to scanning
- Re-open the surface capture in MapRT to assess iso placement and clearance at CT
 - Can adjust the patients position prior to scanning if needed
- During the planning phase – plans can be sent directly to MapRT for clearance assessment
 - MapRT web browser
 - No restrictions on use

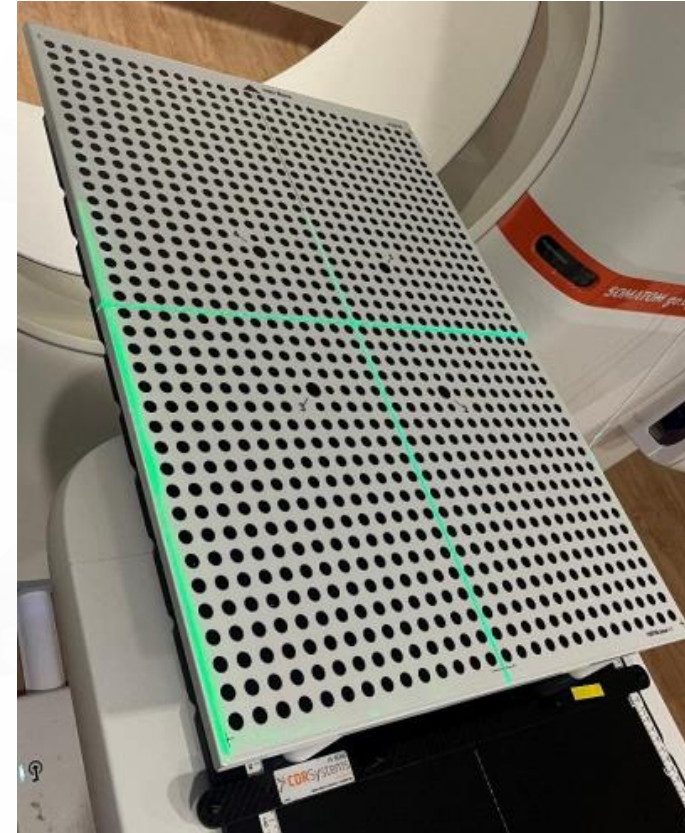
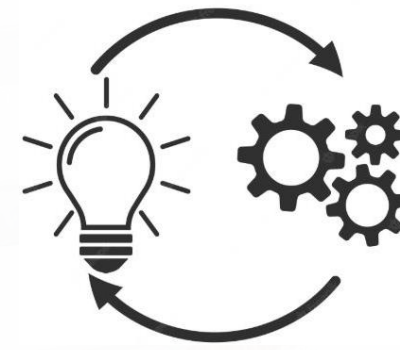


Exporting plans directly from TPS to MapRT



Integration

- Ideally **all** scanned patients will have a MapRT capture
 - Build up a bank of data/patients to assess utilization & future projects
- MapRT capture **after** the CT procedure
 - Staff found this workflow easier rather than before the CT scan
- **Extra step** in the CT process
 - Additional 2-3mins – some patients may not tolerate
- Extra step in the **morning QA** process
 - Daily QA required - additional 5mins



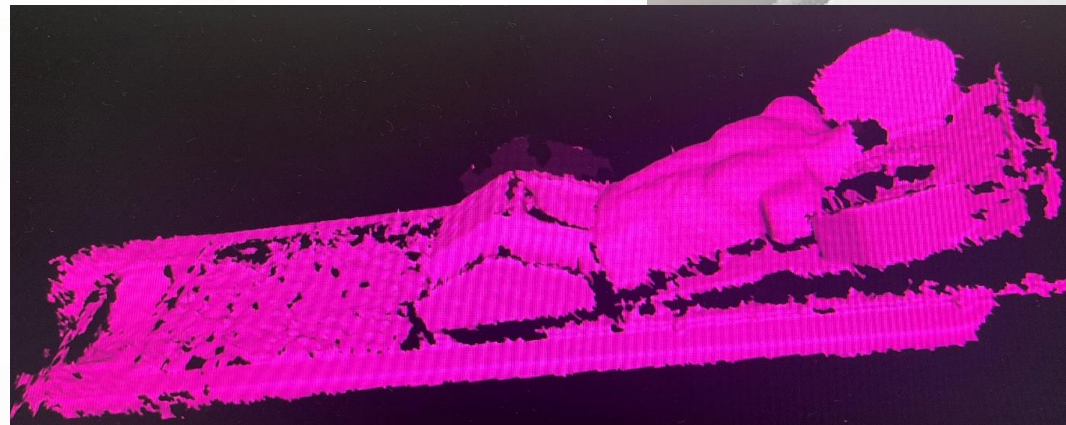
MapRT QA equipment



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Clinical Learning

- **Dark/shiny materials** were not captured by Horizon cameras
 - Known issue – same cameras as AlignRT
 - Cover all equipment with a sheet
- **Remembering the new process**
 - Updated our CT document as a prompt to take the capture before finishing
 - For H&N patients - can take a retrospective capture with the equipment & DICOM co-ords
- Ensure the patient is **exposed** for the capture
 - i.e. don't cover the patient with a sheet – interfere with body contour/capture



Example MapRT Surface capture



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Utilisation

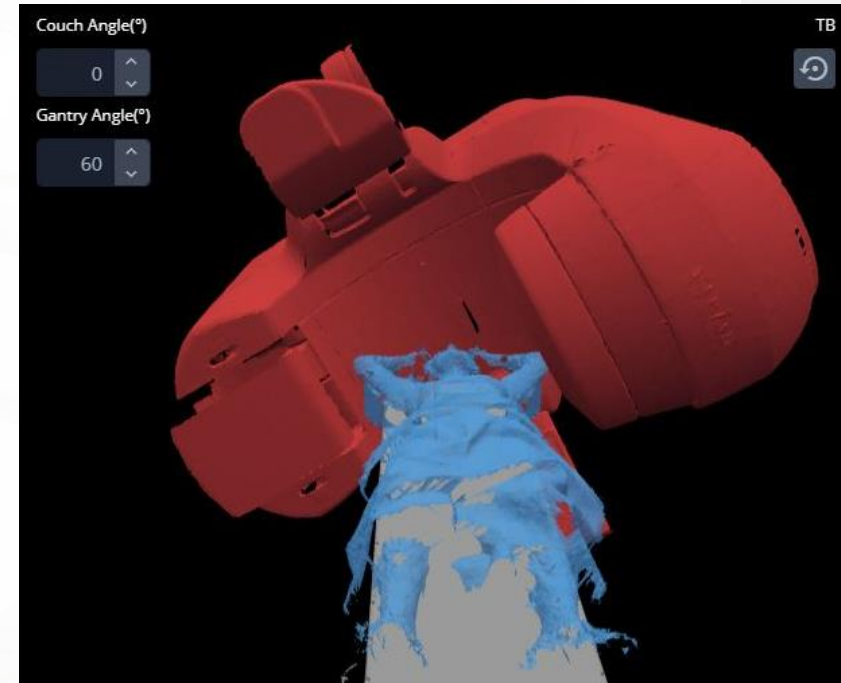
- ✓ BEAM ANGLE SELECTION
- ✓ NON-COPLANAR ANGLE CLEARANCE
- ✓ IMAGING CLEARANCE



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Beam Angles

- Assessing **achievable** beam angles
- Increased uptake in MapRT use with **Breast planning**
 - Contralateral elbow clearance
 - Breast planners now routinely send their plans to MapRT

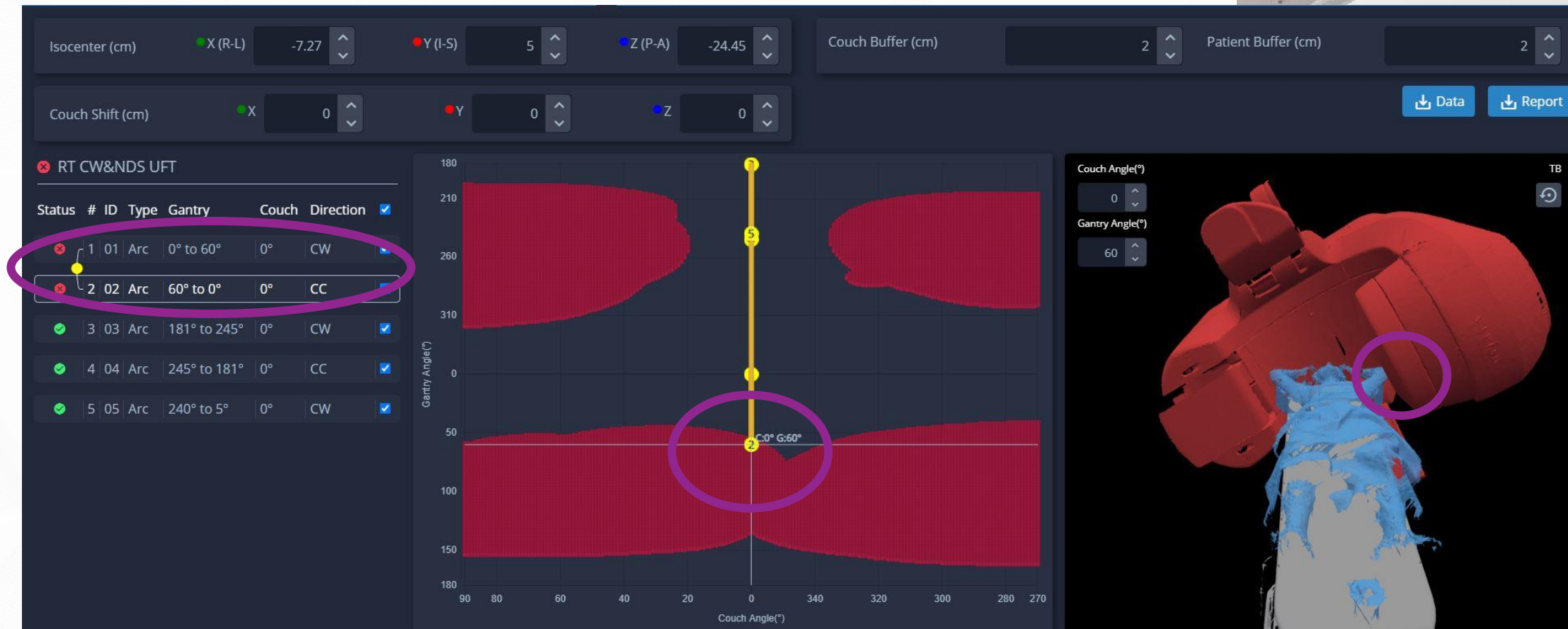


MapRT demonstrating a collision with the patient's contralateral arm



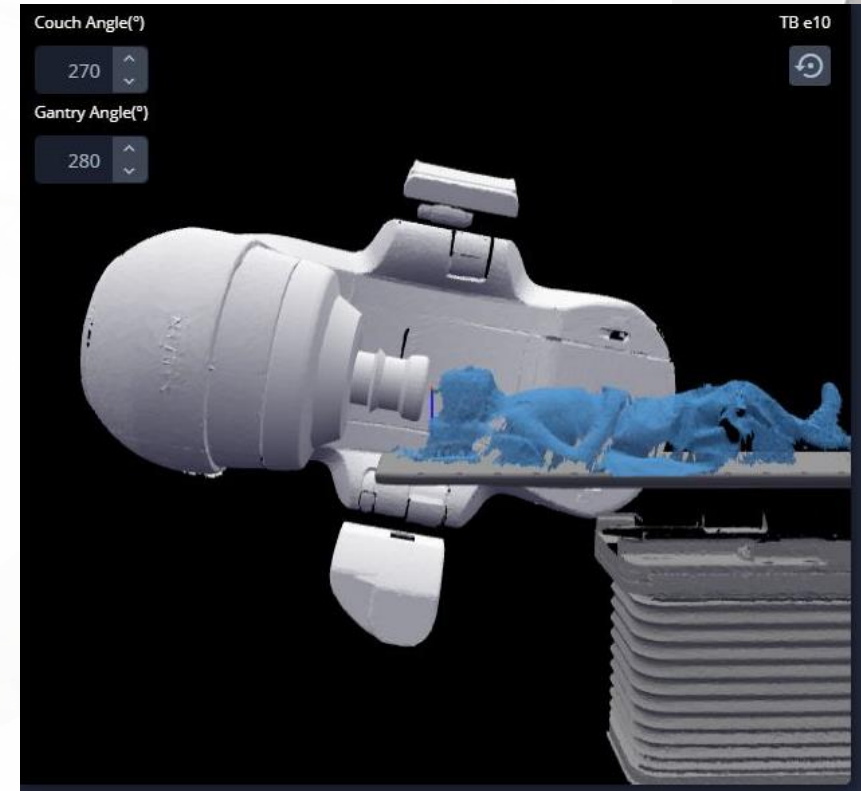
Beam Angles – Clinical Example

- Right sided Chestwall & Nodes patient - VMAT plan
- Plan already approved and QA'd -> sent to MapRT after
- MapRT modelled a collision with contralateral elbow



Non-Coplanar Angles

- MapRT provides great **visualization** of plan geometry
- Given our planners more **confidence** with planning non-coplanar
 - Previously we were often very conservative with floor angles
- Particularly useful for **metastatic skin** patients
 - Electron treatments – applicator clearance
 - Lesions in tricky places – extremities



MapRT demonstrating electron applicator clearance



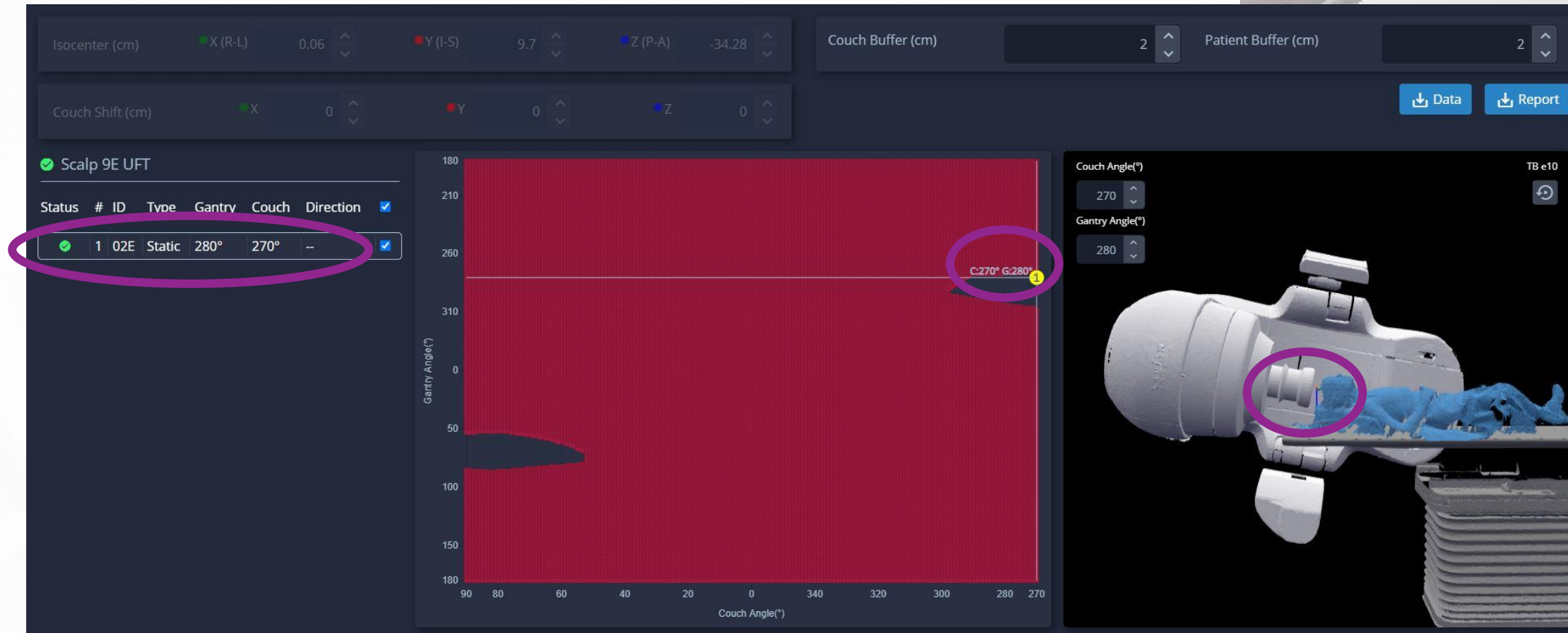
Non-Coplanar Angles – Clinical Example

- Metastatic skin patient, superior scalp volume -> electrons
- Initially planned 100cm to skin, G270 C270 field
- MapRT modelled collision with the neckshape



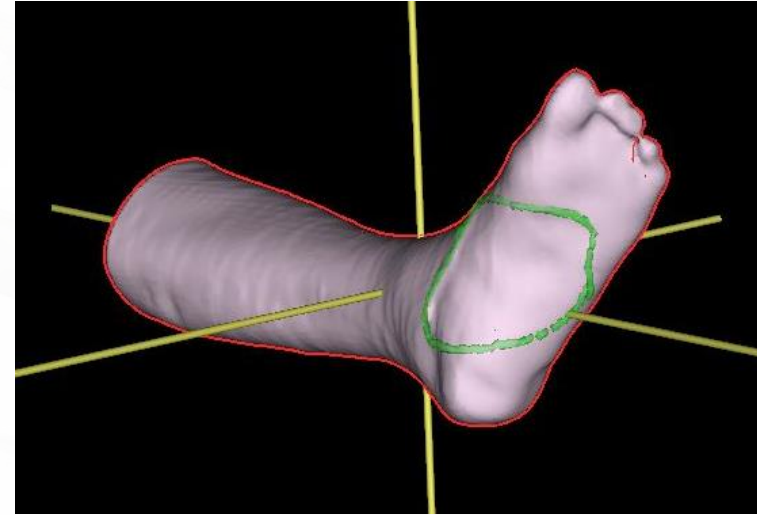
Non-Coplanar Angles – Clinical Example

- MapRT was used during the planning process
- Planner accounted for the clearance issue with a 10-degree gantry adjustment
- MapRT modelled this was safer for clearance

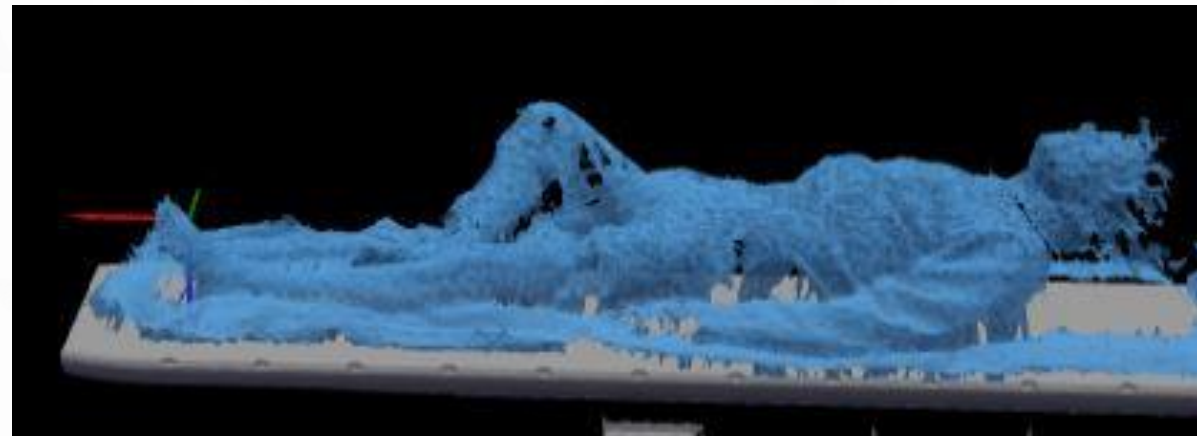


Non-Coplanar Angles – Clinical Example

- Metastatic skin patient – foot lesion
- Dr requested to treat tangentially to spare a lymphatic strip
- Geographically complex considering lesion position and contralateral leg position



Foot lesion clinical mark



MapRT surface capture of patients position at CT



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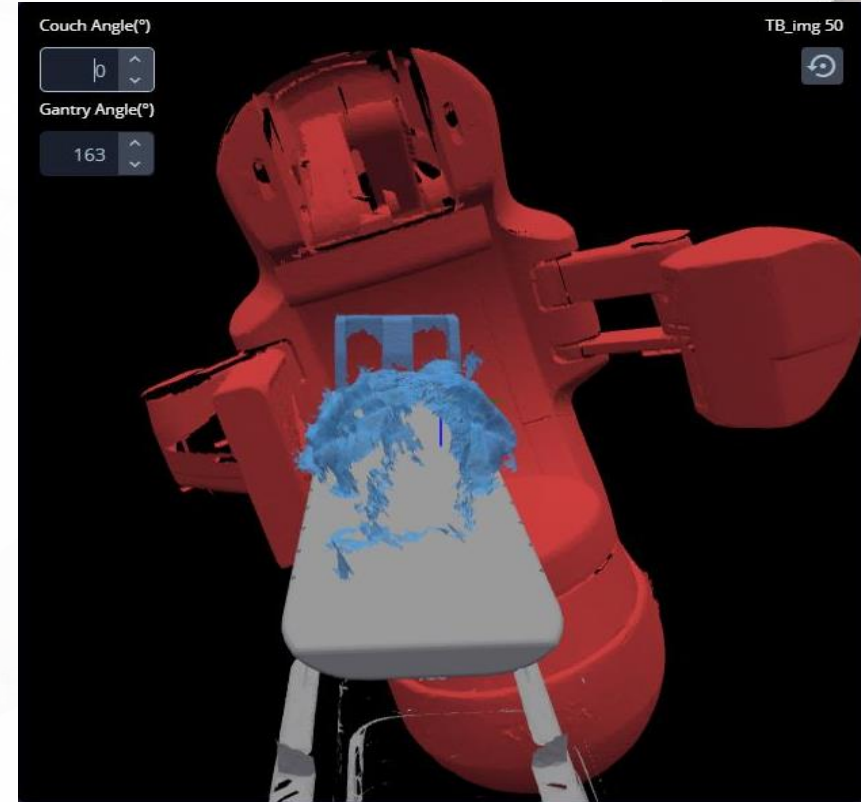
Non-Coplanar Angles – Clinical Example

- Visually demonstrate to the doctor what angles are achievable
- MapRT gave the planners confidence with this tricky volume



Imaging Clearance

- Imaging fields are **not** specifically modelled by MapRT
 - Create dummy fields to export
 - Manually move the interactive gantry graphic to assess clearance with the imaging arms
 - Models kV & MV imaging arms together, or separately at different vertical values.
- CBCT clearance
 - Reduce the need for dry runs
 - Preempt if couch centering is needed
- kV imaging
 - Offset/lateral isocentre patients
 - Selecting better kV angles, e.g. obliques

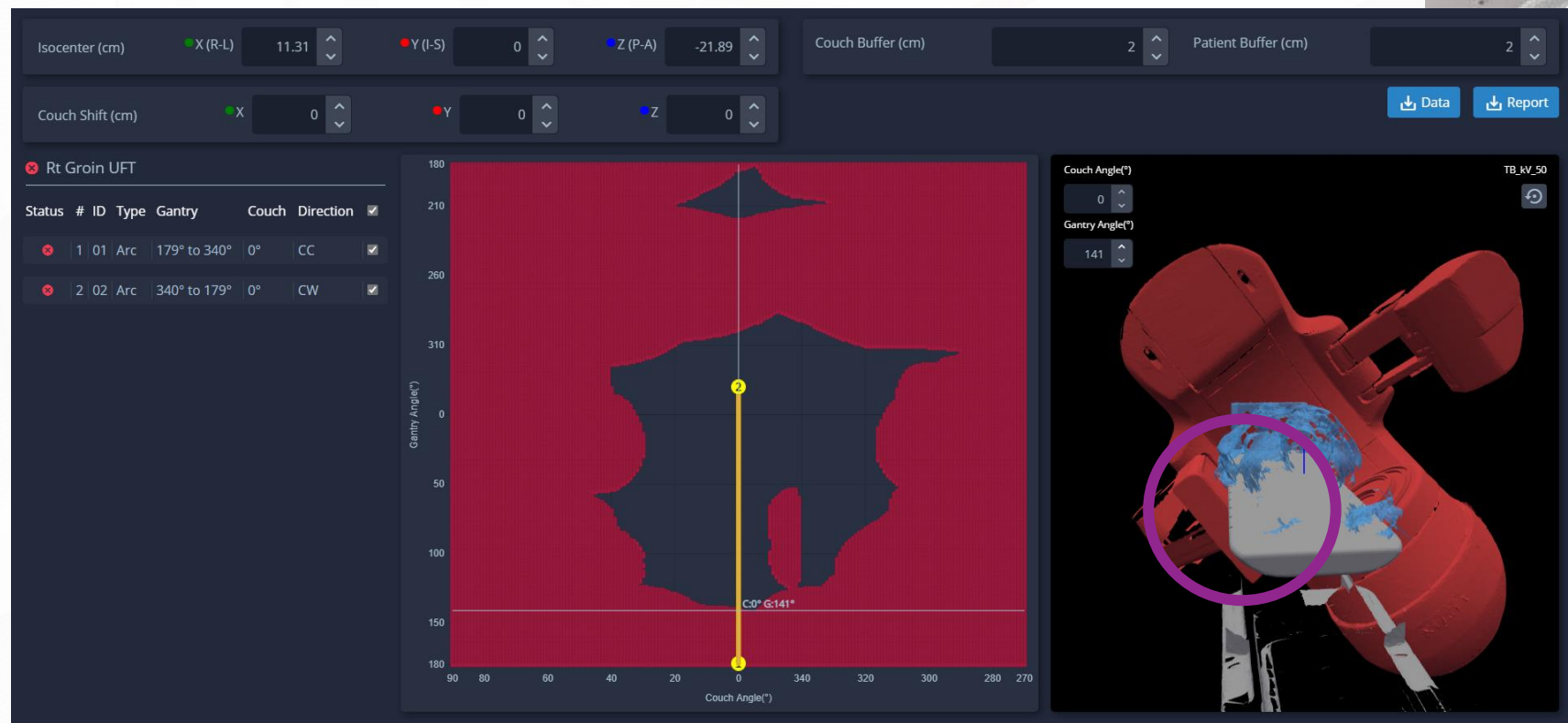


MapRT demonstrating kV imaging panel collision



Imaging Clearance – Clinical Example

- Pelvis patient planned feet to gantry -> very lateral isocentre
- Standard kV imaging angles of kV0 & kV90 did not clear Fx1
- MapRT accurately modelled the most appropriate oblique imaging angles



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Future Projects



- **Non-coplanar Bilateral Head & Neck planning**
 - Address shoulder positioning issues
- **Non-coplanar SABR planning**
 - Assess dosimetric benefits
- **Mono-isocentric bilateral breast VMAT isocenter placement**
 - Couch height clearance
- **Breast CBCT**
 - Spotlight CBCT clearance on treatment
- **Integration into Eclipse**



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Summary

- **Fast and easy** interface to use
 - Sending plans to MapRT is almost instant & provides a great visual of plan geometry
- **Accurately** models plan geometry
 - Reduced the need for replans
 - Reduced repeat QA work and wasted resources
- Gives our planners more **confidence** with non-coplanar planning
 - Able to preempt potential collisions before the patient is on the treatment couch
- Capture process does add an **additional step** to the CT procedure
 - Benefits of using MapRT outweigh this

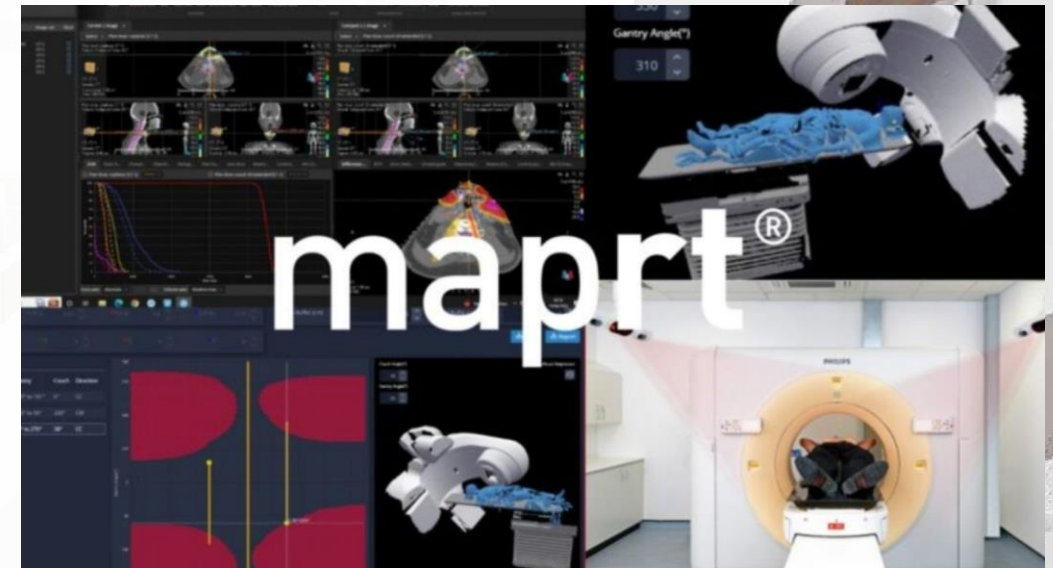


Image courtesy of VisionRT



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Acknowledgments

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Sue Mckenna & VisionRT team



Questions?



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