IHE-RO 2008
Potential Use Cases

IHE-RO Technical Committee

Suggestions from 1/22/2007 Meeting

IHE-RO Potential Use Cases (Technical Committee Suggestions)

- Scheduling for Treatment Delivery
- Multi-Modality Fusion
  - Treatment Planning
  - Treatment Evaluation
- Dose Compositing
- Clinical Trials Submission

Scheduling for Treatment Delivery

- A patient is selected for an imaging / treatment protocol where population-based PTV margins are verified based on daily imaging.
- After imaging, treatment planning, and final approval, the approved treatment plan is selected and transferred to a treatment management system for delivery.

Scheduling for Treatment Delivery (Day 0)

- Orthogonal and portal imaging are done.
- Images are compared to DRR images and approved (by RTT and MD).
- Table positions are acquired and saved for future setup and reference.

Scheduling for Treatment Delivery (Day 1)

- Orthogonal imaging is done and compared with the reference images.
- Patient shifts are computed, and if all shifts are < 3mm, the patient is treated in the current position.
  - If patient shifts are computed as >= 3mm, the patient is moved to the new position and then treated.

Scheduling for Treatment Delivery (Day 2)

- Orthogonal imaging is done and compared with the reference images.
- Patient shifts are computed, and if all shifts are < 3mm, the patient is treated in the current position.
  - If patient shifts are computed as >= 3mm, the patient is moved to the new position and then treated.
- If shifts were required on either of the previous days, then orthogonal imaging is scheduled for the next day.

Scheduling for Treatment Delivery (Day 3)

- If day 1 and day 2 images were within tolerance, no imaging is required. Imaging is now scheduled for every subsequent 5^{th} fraction.
- Otherwise, repeat the day 2 imaging protocol.

Scheduling for Treatment Delivery (Day 4)

- If day 2 and day 3 images were within tolerance, no imaging is required. Imaging is now scheduled for every subsequent 5th fraction.
- Otherwise, repeat day 3 imaging protocol. If imaging is not within tolerance, return plan to dosimetry for possible re-imaging and/or re-planning.

IGRT Treatment Scheduling (3D-3D)

- A patient is selected for an IGRT protocol where 3D-3D matching will be done to verify patient alignment prior to treatment
- After imaging, treatment planning, and final approval, the approved treatment plan is selected and transferred to a treatment management system for delivery. This includes the transfer of the correct 3D image dataset for daily patient alignment.
  - Could be the planning image set or a re-sampled / translated version (e.g. optimized for delivery analysis).

IGRT Treatment Scheduling (3D-3D)

- On each treatment day, the patient is selected and the treatment delivery system retrieves the patient plan and the reference image dataset.
- The patient is approximately positioned, after which a 3D verification image dataset is obtained on the treatment device.
- The 3D verification image dataset is then compared with the reference image dataset and patient positioning changes are determined (if needed).
- The patient is re-positioned and treatment delivered.
- A record of the patient treatment is saved, so that information verifying the correct patient position, as well as the moves required for re-positioning are saved for later analysis.

Multi-Modality Registration For Treatment Planning-1

- A patient is scheduled for a planning CT in a radiation oncology clinic for treatment of an acoustic neuroma.
- A MRI image set, taken approximately 2 weeks prior, is available and pre-loaded on the hospital PACS.
- After CT imaging, it is determined that the tumor is not suitably visible on the CT image dataset and segmentation is done on the MRI axial image dataset. The target GTV, brain stem, and optic chiasm are drawn on the original MRI volume.
- The CT and MRI image datasets are then registered, using the CT-Simulation workstation, reviewed, and all image and segmentation data stored.

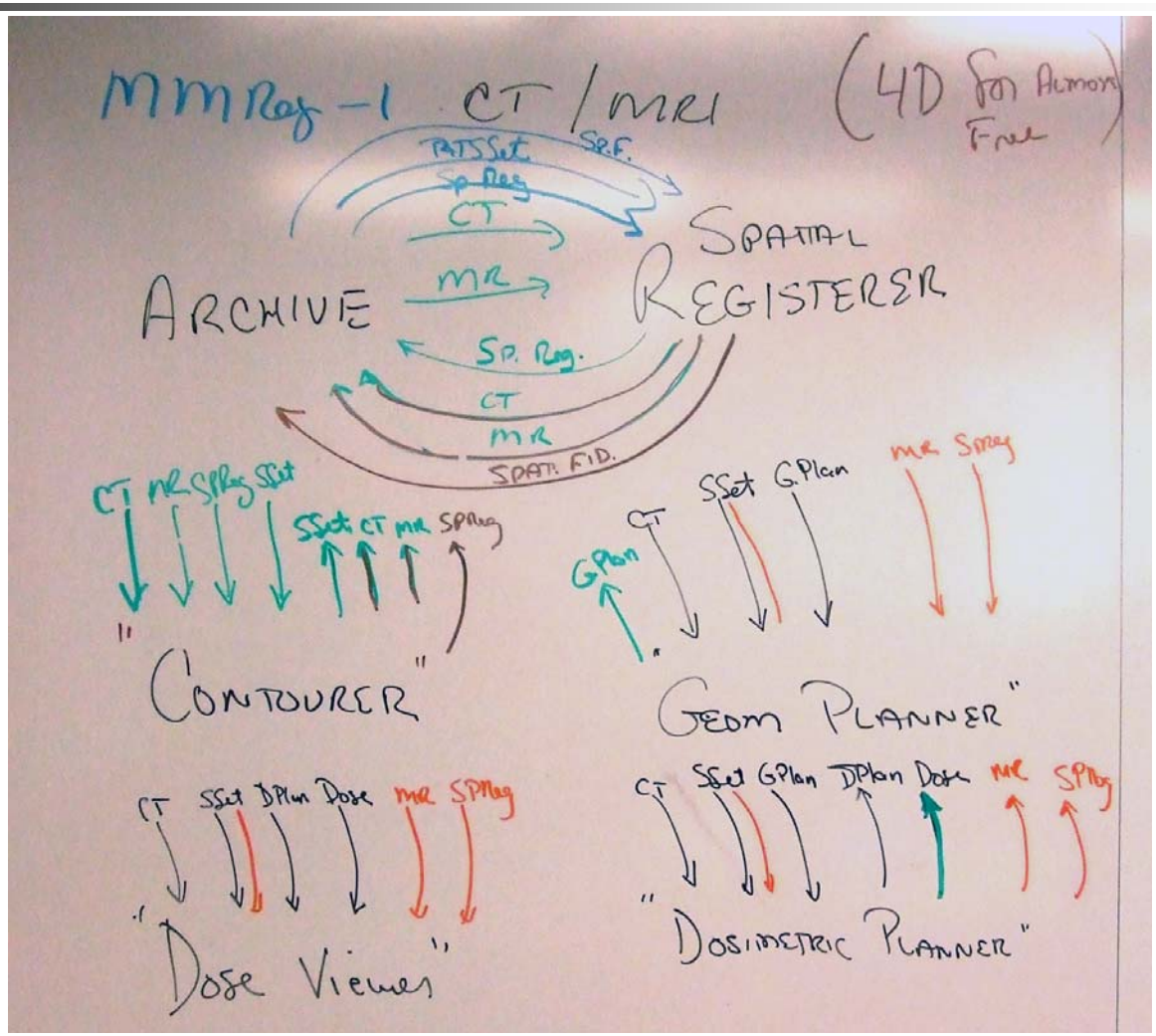
Multi-Modality Registration For Treatment Planning-1

- The CT image dataset and MR-based segmentations are then retrieved by the dosimetrist on a planning workstation.
- The CT images and the previously segmented target volume and OARs are reviewed, and additional OARs are defined as requested by the radiation oncologist.
- Planning then continues to beam definition and dose calculation

Multi-Modality Registration For Treatment Planning-1

- After dose calculation, the radiation oncologist is notified that a treatment plan is ready for evaluation
- The MD reviews DVHs and then examines the dose distribution, using both the CT and MRI image datasets to observe coverage of the target volumes and avoidance of the OARs.

Multi-Modality Registration For Treatment Planning-1



Multi-Modality Registration For Treatment Planning-2

- A patient is scheduled for a planning CT in a radiation oncology clinic for treatment of a lung lesion.
- As part of the workup, a PET scan was ordered, and the resultant images have been stored on the Radiology PACS.
- The planning CT is done and the images transferred to a CT-Simulation station for segmentation.

Multi-Modality Registration For Treatment Planning-2

- At the CT-Simulation workstation, the CT and PET images are registered and fused.
- Using the PET images, the GTV and nodes are segmented. The contours are also viewed overlaid on the CT images for verification.
- Once the nodes have been initially drawn, the borders are touched up using the CT anatomy. When completed, the results are reviewed, and all images and segmentation are stored.

Multi-Modality Registration For Treatment Planning

- Q1: Which modalities, and how many, would be a reasonable initial set that manufacturers could implement in the required time frame?

- Q2: Should the planning system be required to load in the non-planning image sets and display them aligned with the planning set? Obviously this would be a useful feature, but considering the implementation overhead, is this a strong requirement?

Composite Dose Display

- A patient is enrolled in RTOG Head & Neck protocol 0522
- The patient is randomized to the accelerated RT + cisplatin arm
- After evaluation, 3D radiation therapy is selected for treatment of this patient
- A planning CT is done and transmitted to the planning workstation.

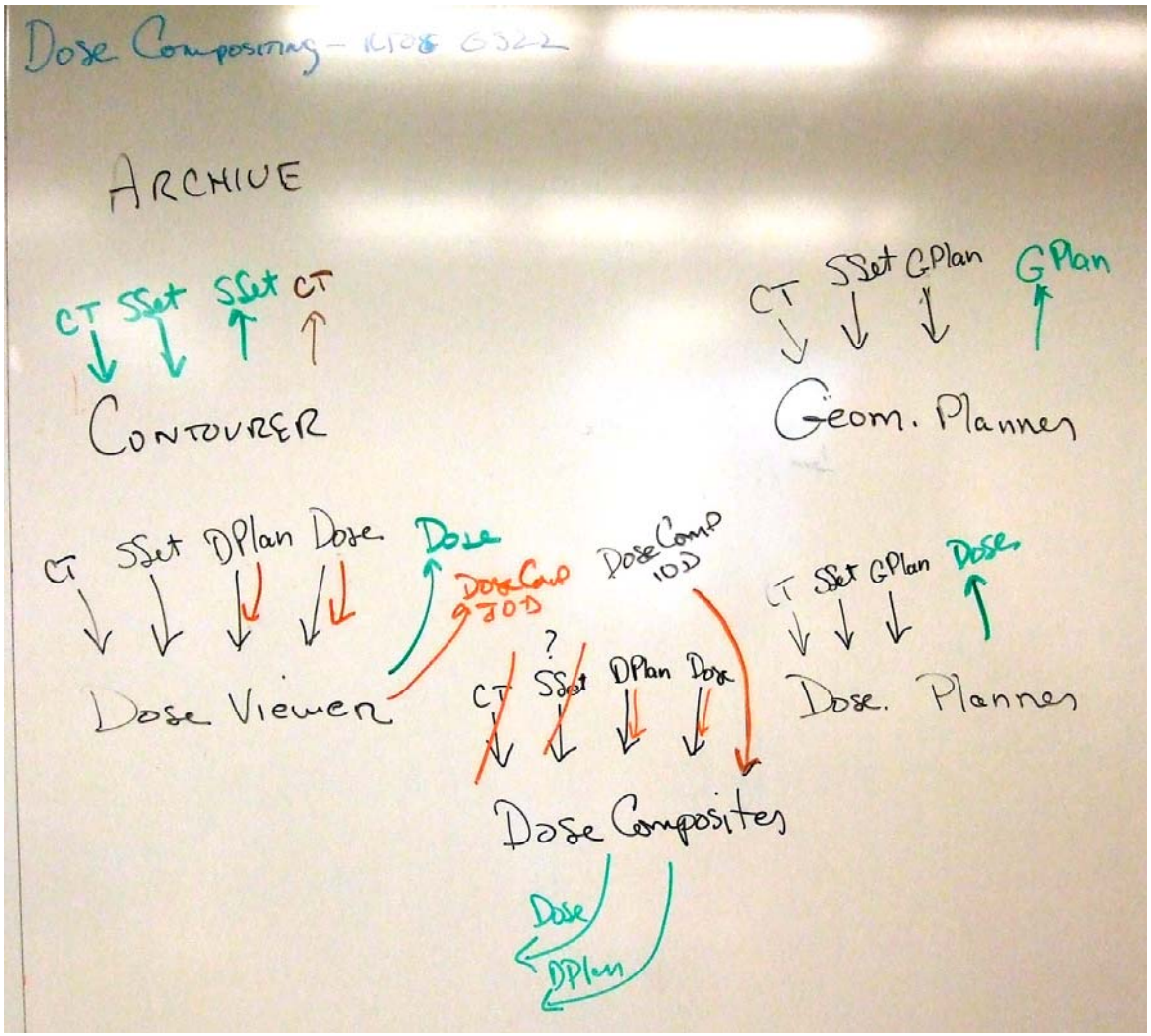
Composite Dose Display

- Following the protocol, an initial plan, encompassing the gross and clinical disease is created, delivering 1.8 Gy/fraction for 30 fractions.
- A second boost plan, encompassing the gross disease and involved nodes, is created, delivering 1.5 Gy/fraction for 12 fractions. This boost treatment will be started on fraction 19 and delivered 6 hours apart from the primary treatment.
- A third plan, treating the lower neck nodes, will be treated using AP/PA fields delivering 1.8 Gy/fraction for 30 fractions.

Composite Dose Display

- Treatment evaluation is accomplished by reviewing dose distributions and DVHs for each individual plan, the overlapping plans, and all three plans together.
- Doses must meet the requirements of the protocol for plan normalization, minimum and maximum doses, target coverage, and OAR avoidance.

Composite Dose Display



Clinical Trial Submission

- The plans, including CT image dataset, regions of interest, dose distributions, and DVHs are anonymized and formatted for transmission to the ATC.
- ATC submission is done.

Clinical Trial Submission