



Verification of Deformable Image Registration (DIR) Program For Clinical Application In Head and Neck Cancer

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Purpose:

Velocity™ program can be used for deformable image registration (DIR) of multimodalities imaging, dose accumulation, PET contouring and BED calculation. Velocity™ version 3.2.1 (Varian Medical Systems, Palo Alto, CA) is one of commercial DIR software based on multiresolution B-spline algorithm. DIR has been applied for contouring, adaptive re-contouring, tracking and summing dose. However, the reliability of DIR should be verified before clinical used.

Materials:

Anthropomorphic Rando™ phantom (head and neck part) with 12 inserted fiducial markers was used for deformable registration evaluation. For evaluation of DIR, the translation (lateral, longitudinal and vertical directions), rotation, pitch and yaw rotation of Rando™ phantom were performed for calculation of target registration error (TRE). Eclipse™ treatment planning v13.6 was used for TRE by measuring the center of line profile of fiducial markers among translated phantoms. The 9 cases of head and neck images with CT, replan CT and CBCT images were used for evaluation the TRE and consistency. The 13 anatomical points were defined by radiation oncologist.

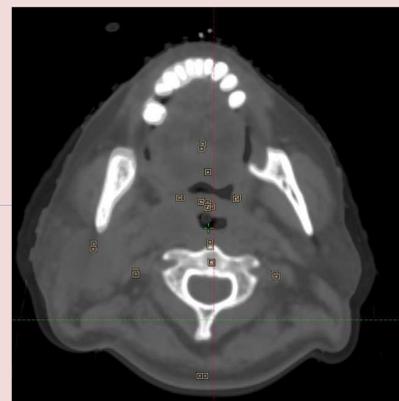


Figure 1: Rando™ phantom with 12 fiducial markers **Figure 2:** CT images with 13 anatomical points

Results and Discussion:

For anatomical phantom, TRE was 0.93 ± 1.01 mm with maximum value of 5.5 mm. The highest value was found at the border bone region. For head and neck images, TRE was $2.4 \text{ mm} \pm 1.76 \text{ mm}$ (TG-132 tolerance is 2-3 mm), maximum differences ($\approx 4\text{-}5$ mm) were found at uvula and epiglottis. For Inverse consistency method, we found acceptable percentage difference of PTV-HR and most of OARs. According to TG-132 recommendation, Velocity™ was reliable with TRE less than 2 mm. The deformable image registration can be used for head and neck region for uncomplicated purpose such as registration for adaptive planning. However, visual inspection should be done especially in bone and border surface.

Conclusions:

Velocity™ can be used for image registration in head and neck region. For more reliability, visual inspection especially in border bone region and locally ROI defined of deformable registration were recommended.

References:

- Garcia-Molla Rafael, et al, Validation of a deformable image registration produced by a commercial treatment planning system in head and neck, European Journal of Medical Physics, 2015.
- Pukala Jason, et al, Benchmarking of five commercial deformable image registration algorithms for head and neck patients, Journal of applied clinical medical Physics, 2016.