AbstractID: 6829 Title: A biomechanical phantom for validation of deformable multimodality image algorithms

Purpose: Quantitative validation of multimodality deformable registration and segmentation algorithms is a challenging problem. To address this issue, we built a deformable multimodal imaging phantom system based on a preserved swine lung and a computer controlled airflow system. Comparing to most other digital and physical phantoms, this phantom is truly deformable, MRI compatible, biologically similar to human tissues, and more representative of clinical conditions. The phantom was imaged with CT and MRI protocols and yielded high resolution benchmark images. Our goal is to utilize these benchmark images to provide realistic and robust validation of medical image processing algorithms in radiotherapy applications, including multimodal deformable image registration, segmentation, tissue, as well as 4D-CT imaging and reconstruction methods.

Method and Materials: After the preserved swine lung leakage problems were addressed, the lung was inflated using a computer controlled airflow system and then imaged. 3D-CT and MRI scans were taken at certain tidal volumes. For 4D-CT imaging, the lung was scanned according to 4DCT protocol (Low, Med Phys v30, p1254-63, 2003) while the airflow cycle in the lung was computer-controlled. For demonstration, we performed deformable CT-CT registration and CT-MR manual fusion on the collected images. 3D-CT images were acquired at different spatial resolutions, up to image dimension of 1024×1024×530 and voxel volume of 0.244×0.244×0.67 mm.

Results: 3D-CT images allow us to clearly identify up to the 6^{th} airway bifurcation. MR images were also of adequate quality.

Conclusion: We have built the deformable phantom system and obtained images of high resolution with 3D-CT, 4D-CT and MRI. The images are expected to be very useful for validation of different medical image processing algorithms. We conclude that this system is promising tool for investigating and validating deformable image algorithms for radiotherapy.