AbstractID: 13925 Title: Sensitivity of 4D-CT pulmonary ventilation imaging to deformable image registration algorithms and metrics

Purpose: A novel pulmonary ventilation imaging technique based on 4D-CT has advantages over existing techniques (*e.g.*, SPECT). 4D-CT ventilation imaging consists of deformable image registration (DIR) and displacement vector analysis for computing the ventilation metric. However, there are various DIR algorithms and metrics that yield different ventilation images. The purpose of this study was to quantify the sensitivity of 4D-CT ventilation imaging to DIR algorithms and metrics. **Method and Materials:** 4D-CT ventilation images were created for 9 patients in an IRB-approved study using different combinations of two DIR algorithms: surface-based registration (DIR_{sur}) and volume-based registration (DIR_{vol}), and two metrics: Hounsfield unit (HU)-change (V_{HU}) and Jacobian determinant of deformation (V_{Jac}), *i.e.*, four different ventilation images for each patient. The analysis compared voxel-based correlations between different ventilation images, and coefficients of variation (CV) as a measure of heterogeneity. The relative and absolute lung volume changes were also compared, *i.e.*, calculated vs. measured (ground truth). **Results:** Different DIR algorithms and metrics yielded spatially variant 4D-CT ventilation images. The voxel-based correlations between different ventilation images were inconsistent and ranged from weak (Patient 3, V_{Jac}^{sur} vs. V_{HU}^{vol}, $r = 0.084$) to strong (Patient 7, V_{HU}^{sur} vs. V_{HU}^{vol}, $r = 0.819$) correlations. V_{HU} resulted in significantly higher CVs (*e.g.*, 3.17 ± 1.64 for V_{HU}^{sur}) than V_{Jac} (0.71 ± 0.27 for V_{Jac}^{sur}) ($p = 0.001$). There were high correlations between the calculated and measured lung volume changes for all of four ventilation images (r range, 0.965-0.993, $p <0.001$). **Conclusion:** This study has demonstrated that the regional distribution and heterogeneity of 4D-CT ventilation are sensitive to DIR algorithms and/or metrics, while the global accuracy is not sensitive. Careful validation studies are needed prior to its clinical application. **Conflict of Interest:** SK, CL and JB are employees of Philips Research Europe.