AbstractID: 3092 Title: Enhancing 4D PET through Retrospective Stacking

**Purpose:**

Four-dimensional (4D) PET presents challenges distinct from 4D CT owing to radiotracer dose limitations. A single-bed field-of-view (FOV) PET scan typically requires several minutes to acquire adequate data for reconstruction, necessarily spanning several respiratory cycles and smearing the radiotracer signal within a given lesion over an increased volume. Although prospective or retrospective gating captures the PET image at a single point in the respiratory cycle, restricting the data to events within the gating interval increases the signal-to-noise ratio (SNR). We propose a method, coined “retrospective stacking” (RS), to combine the data from the entire respiratory cycle through deformable registration. In addition, we use the transformation maps to generate a 4D PET with statistics comparable to the single RS image.

**Method and Materials:**

A single FOV of a pancreatic cancer patient was acquired via the gated PET mode on a GE Discovery ST PET-CT scanner. These gated images were registered using a mutual information / B-splines registration algorithm, and superimposed. A 4D PET series spanning the full respiratory cycle was generated, and fused onto a 4D CT.

**Results:**

The SNR of the RS image showed an increase of 15% over a single gated reconstruction. Activity-volume histograms of radiotracer activity surrounding the pancreatic lesion revealed that the ungated PET showed 33% greater tumor volume (using a 40%-of-maximum threshold) than the RS image. The reconstructed 4D PET fused well with the 4D CT, providing a clearer view of radiotracer distribution over the respiratory cycle than was possible using gated reconstructions.

**Conclusion:**

Retrospective stacking enabled better integration of temporally varying PET and CT series by reducing radiotracer smearing due to respiratory motion, while at the same time increasing the SNR beyond the poorer statistics inherent in gated PET acquisition. Noise-reduced 4D PET images could also be generated for fusion with 4D CT.