

AbstractID: 8904 Title: Four-dimensional Motion Detection to Discern Respiratory from Biological Changes in Treatment Response Assessment Using Molecular Imaging Biomarkers

**Purpose:** The in-vivo imaging of tumor biology through positron emission tomography (PET) scans has become an invaluable tool for therapy response assessment since it provides tumor response data at early treatment stages. However, imaging in-vivo small molecular changes in tissues subject to respiratory motion is infeasible as the PET tracer is smeared during the acquisition process introducing errors up to 75% associated with degraded tracer activity. The purpose of this study was to develop a motion detection system that quantifies respiratory changes using spatio-temporal Bspline deformable image registration for analysis of motion-degraded PET datasets.

**Method:** A clinical software tool implemented the Bspline deformable image registration method. Algorithm output is a motion-corrected 4D PET image containing only treatment-induced changes. The motion-free dataset can be summed to provide a simple 3D dataset that is used to for therapy evaluation using the standard tools developed for motion-free treatment sites.

**Results:** Capabilities of motion correction algorithm were established in studies on tumor motion in dynamic phantoms using checkerboard and surface distance tools and in patients using the convergence analysis method. The BSpline model was able to reproduce respiratory motion with a maximum error of 3 mm on five clinical cases of lung lesions.

**Conclusion:** The integrated motion-correction 4D PET system will provide a standardized protocol for characterization of tumor response using a combination of conventional and motion-sensitive measures. The algorithm discerns between respiratory and treatment induced changes and thus, enables individual tumor response and evaluation of anti-angiogenic therapies in images of thoracic tumors affected by respiration.