# AbstractID: 5638 Title: Joint Estimation of Motion and Activity Concentration for 4D Gated PET Studies

**Purpose:**
Gated PET acquisition has been traditionally used to address the respiratory/cardiac motion induced artifacts. However, gated PET images usually have poor image quality due to insufficient photon counts. In this regard, various efforts have been made to estimate the motion information from the gated PET images first, and then use this information to produce motion-free, high quality images. The purpose of this study is to combine the two inter-related tasks—motion estimation and image reconstruction, into one single process. A potential advantage of such an approach is a more accurate estimation of the motion information, as well as a better quality of the reconstructed image.

**Method and Materials:**
Motion estimation and image reconstruction are jointly performed by maximizing a modified likelihood function that incorporates motion information. A computer simulation was performed on a 2D digital phantom placed in a simulated PET scanner to test the feasibility of this approach. The digital phantom consisted of a hot sphere moving sinusoidally within a warm background. The motion of the sphere was discretized into 10 steps. This simulated a tumor in the patient body influenced by the respiratory motion during a gated data acquisition using 10 time frames. The simulated PET scanner consisted of two parallel gamma cameras each having 140 detectors, and could rotate in 280 angular steps. Projection data were modeled to follow a Poisson statistics, with 20% of random counts.

**Results:**
The jointly estimated image recovered the shape of the moving object while still preserved a good image quality. Quantification error was reduced by 21.2% when compared to the static reconstruction, and SNR was improved by 185% when compared to the gated image.

**Conclusion:**
The joint estimation approach we have proposed has a good potential in motion artifacts correction for 4D PET images.