Abstract ID: 16942 Title: A calibration phantom for dual-modality mechanical alignment: numerical simulation

Purpose: Accurate hardware alignment is important for dual modality medical imaging devices, such as PET/CT. We propose an automated retrospective dual-modality mechanical alignment to improve mechanical accuracy for combined medical imaging devices. We design and validate, by numerical simulation, a calibration phantom for fast dual-modality hardware alignment.

Method and Materials: We design a calibration phantom with a curve marker, which can be fabricated from a segment of flexible thin tube containing a mixture of contrast and radio-activity. The spatial transformation of two modalities is then estimated from reconstructed volumes of each modality. To do this, the curve marker at each slice can be extracted by calculating thresholded center of mass. The spatial transformation is estimated using Iterative Closest Point (ICP) algorithm.

Results: We simulated and compared different winding scheme (including normal helical, variable pitch helical, helical with straight ends and two-way helical) of curve marker. A two-way helical curve marker formulates a better conditioned estimation problem, which results in higher accuracy and faster convergence speed. In addition, simulation results show that the curve marker we proposed is robust to handle practical cases with added noise and discontinuity caused by air bubble.

Conclusions: We can use a calibration phantom with a two-way helical curve marker to efficiently and accurately determine the spatial transformation for dual-modality mechanical alignment. The shape of curved marker can be in either 2D or 3D.