AbstractID: 7368 Title: System for determination of 3D cardiac motion from biplane imaging

Purpose: Biplane imaging offers the ability to determine 3D motion of objects of interest at high frame rates (> 30 fps) and does not suffer from out of plane motion issues. We have developed methods for rapid determination of 3D motion of tagged objects, e.g., points of interest in the heart.

Materials and Methods: Fourteen metallic spherical markers (Φ1.5 to 4.5mm) were surgically implanted to tag major muscle bundles in both atria in pigs. The pigs were then imaged by biplane fluoroscopy at 30 frames per second. Images were corrected for distortion, and markers indicated in one of the frames. Markers were identified automatically in subsequent frames using cross-correlation techniques. The imaging geometry was determined using the enhanced-Metz-Fencil technique, after which, the 3D positions of the markers were determined and displayed for each time point. The motion of the various markers was analyzed using the Procrustes technique. The vectors of movement of individual points as they relate to other points were determined to identify centres of contraction.

Results: Automated bead tracking takes approximately 1 minute and is 100 percent accurate for slowly moving beads and beads that do not overlap with approximately 80% accuracy overall. The 3D positions were reproducible across cardiac cycles. The average RMS difference of marker positions for the same cardiac phase was approximately 0.5 mm. The average point excursion during a heart cycle was 3.6 mm. Data analyses revealed a dominant dynamic directionality towards a central point or plane suggesting a common limb involved in bi-atrial mechanics.

Conclusion: This system provides rapid generation of 3D motion of tagged regions of interest in the atria. These data will provide a useful basis for analysis of cardiac motion. The ability to link structure and function by these techniques can impact the fields of cardiac surgery, pacing, and electro-physiology.