First cardiac tomographic images on a C-arm based angiography system with retrospective cardiac gating

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Purpose : To investigate visualization of cardiac structures in 3D volumes acquired using an interventional flat-panel angiographic computed tomography (ACT) system.

Methods and Materials:
A Siemens AXIOM Artis dTA flat-panel angiography system was modified to allow acquisition of several bi-directional sweeps through 200°, acquiring images around an object during synchronized acquisition of the ECG signal. Protocols with 4 to 6 sweeps were investigated, with the number of images per sweep ranging from 96 to 247, and total acquisition time ranging from 16 to 40 seconds. Our software for retrospective gating allows specification of a cardiac phase for reconstruction, and then selects for each angle the image that is closest to this cardiac phase. Standard ACT software (DynaCT) is used for image reconstruction. 3D image quality was tested in two *in vivo* porcine models (heart rate ~ 90 bpm) for data acquired during injection of 2 cc/s and 3 cc/s (282 mg/ml I) into the inferior vena cava and was compared to the gold standard, clinical gated CT images acquired on the same day with the same injection protocol (Siemens Sensation 16, single rotation in 0.42 s). The lengths of the right coronary artery (RCA), left anterior descending (LAD) and left circumflex (LCx) were measured in the clinical CT and ACT volumes.

Results:
Length measurements of the RCA, LAD and LCx showed that for experiment #1, a left-dominant heart, 35%, 64% and 98% of the vessels respectively could be seen in the ACT images relative to the clinical CT images. For experiment #2, a right-dominant heart, 85%, 65% and 45% of the vessels could be seen in the ACT. All four heart chambers could be clearly visualized in the ACT volumes for reconstructions at 80% of the cardiac cycle, as could the coronary sinus and the pulmonary arteries and veins.

Conclusions:
For the first time, it was possible to visualize cardiac anatomy in 3D using an angiography system and intravenous contrast injection. Further optimization to reduce radiation dose and acquisition time is underway. Providing volume reconstructions during interventional procedures will be useful for on-line planning and guidance in a number of applications, including electrophysiology ablation procedures and interventional vascular procedures near the heart.