



June 23–27, 2009
Estrel Hotel, Berlin, Germany

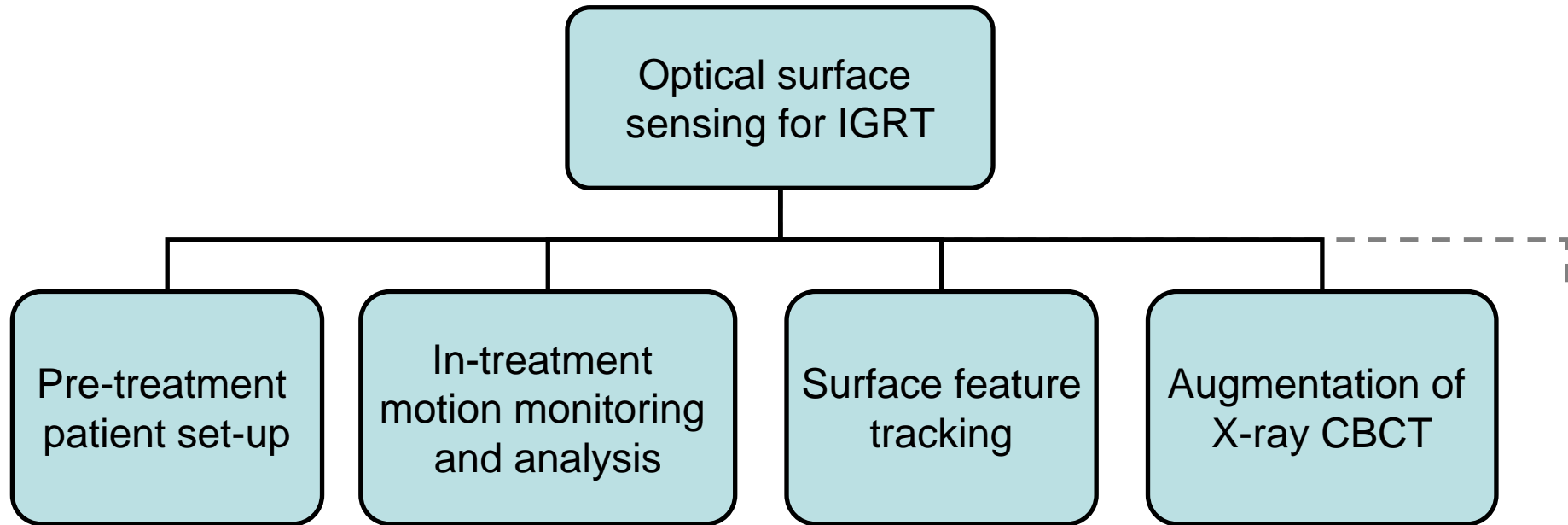
Synchronization of real-time optical surface sensing with cone beam CT acquisition for image guided radiotherapy

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The Christie NHS Foundation Trust, Manchester

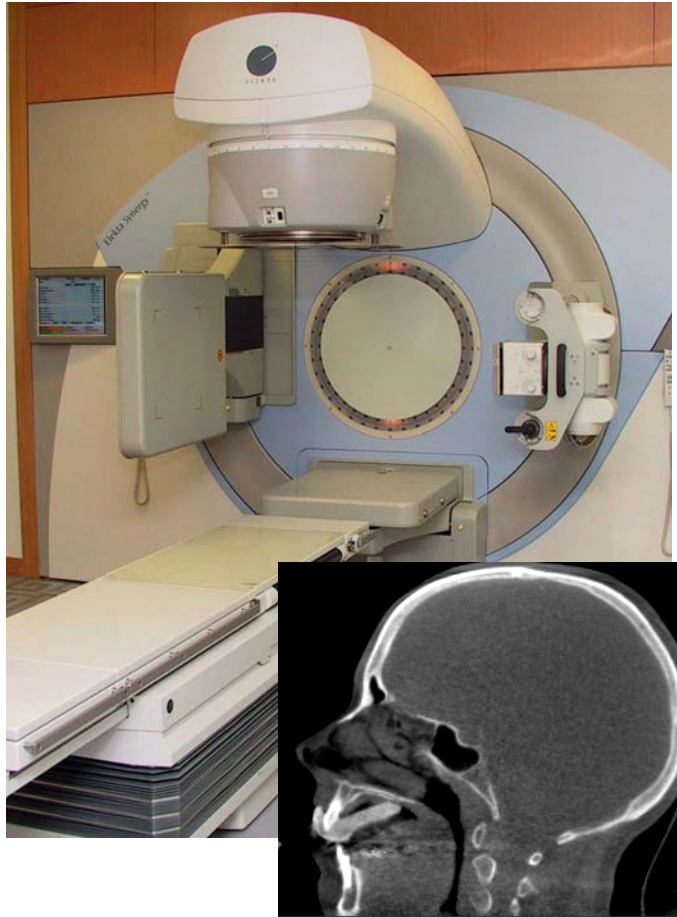
25 June 2009

Overview



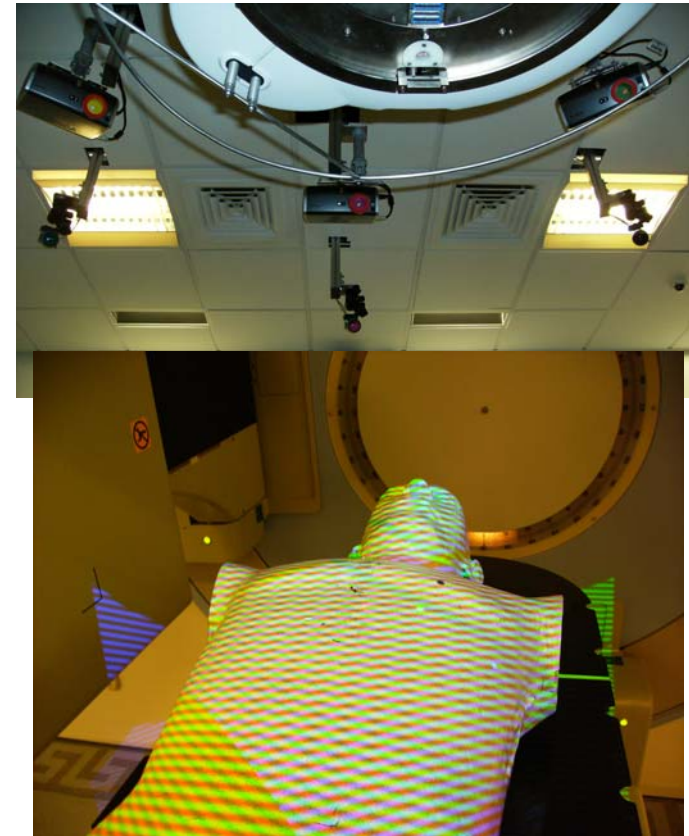
Introduction

Cone beam CT



- ✓ Internal anatomy
- ✗ Not real time

Optical surface sensor

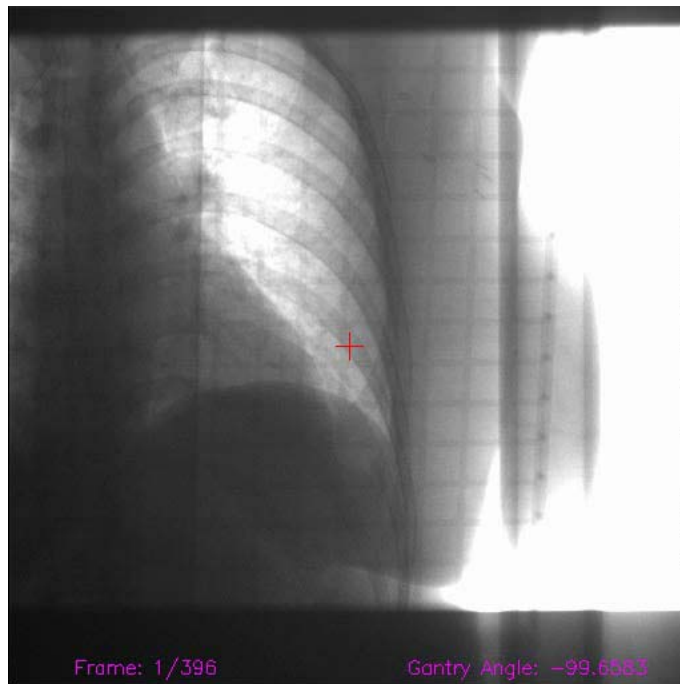


- ✓ Dynamic / Real time
- ✗ Only surface data

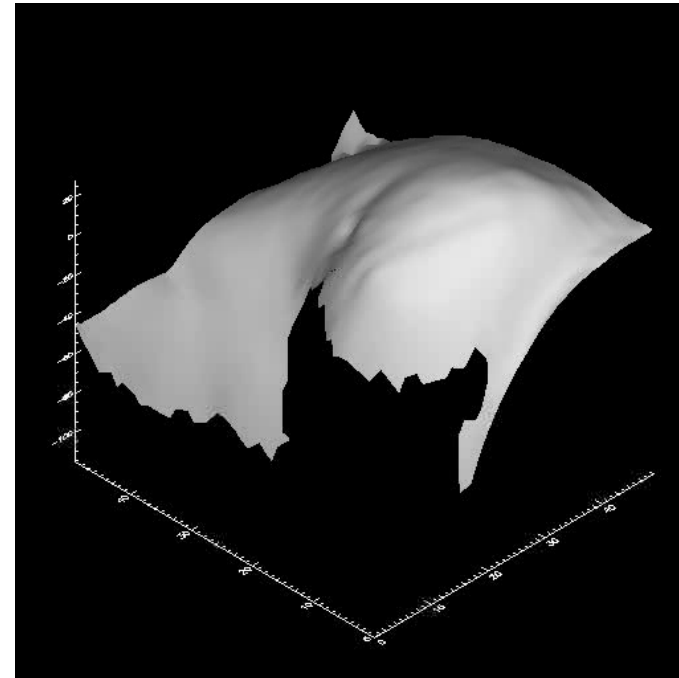


Combine data from CBCT and optical sensor

CBCT projections



Optical surface

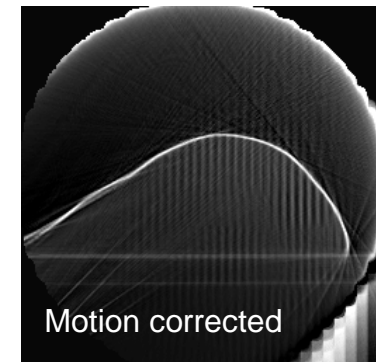
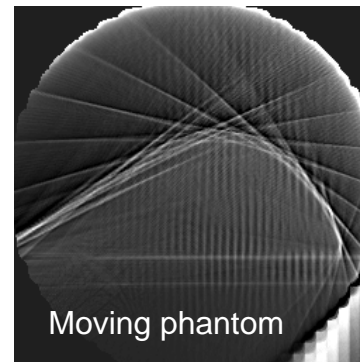
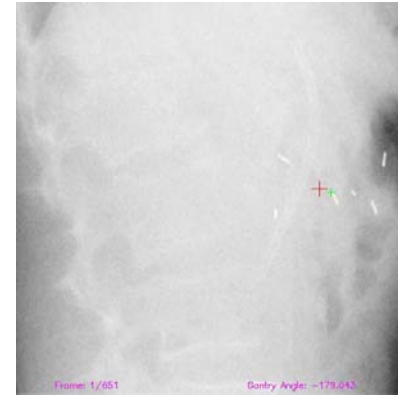


Acquired simultaneously

- Combining the two requires synchronised data capture

Why?

- Simultaneous tracking of surface and internal fiducials
- Phase sorting of kV projections based on optical data (4D CBCT)
- Motion correction of CBCT

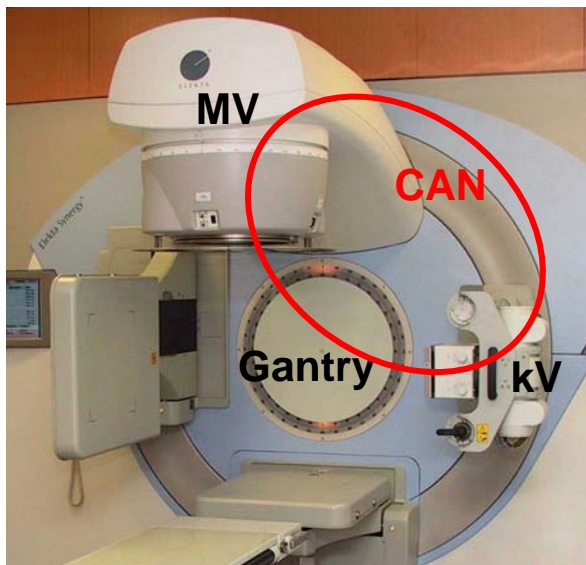


Methods

Synergy™ uses a CAN Controller Area Network

CAN links CBCT & mega-voltage systems

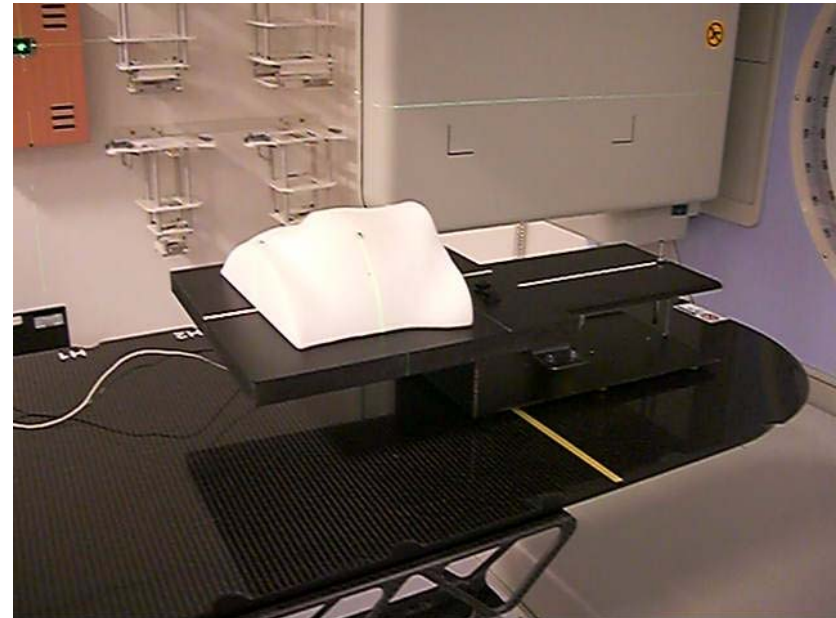
The CBCT system gets gantry angle stamps via the CAN.



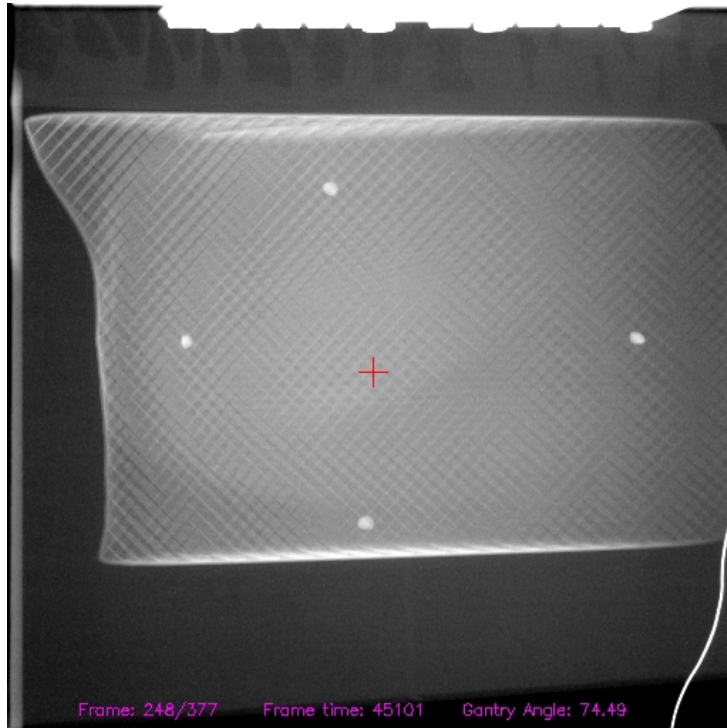
- Create interface to CAN to read:
 - kV acquisition on/off
 - current CBCT frame time
 - current gantry angle
- This data used to tag each optical video frame

Validation

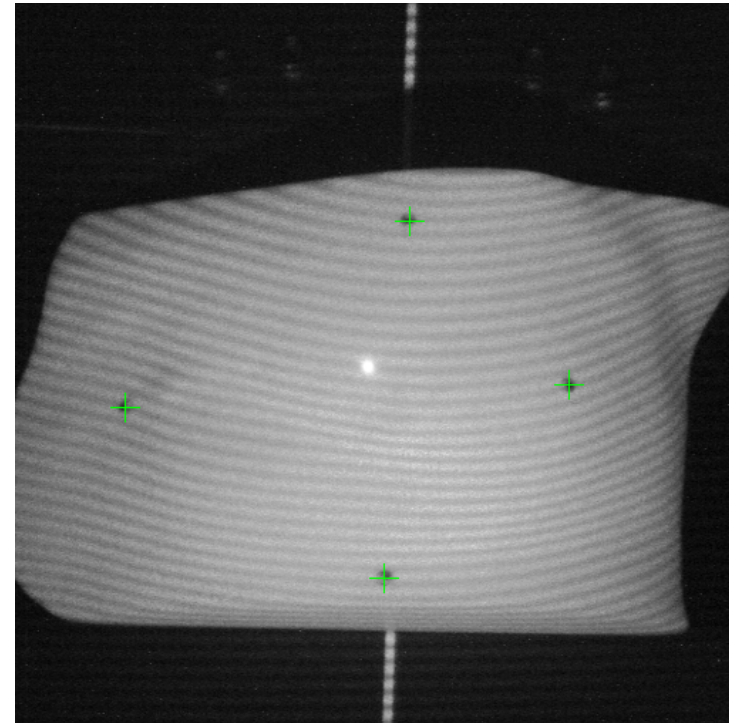
- Phantom produced from breast contours
- Placed on “breathing” stage
- Surface markers visible in x-ray and video images



Synchronized data capture



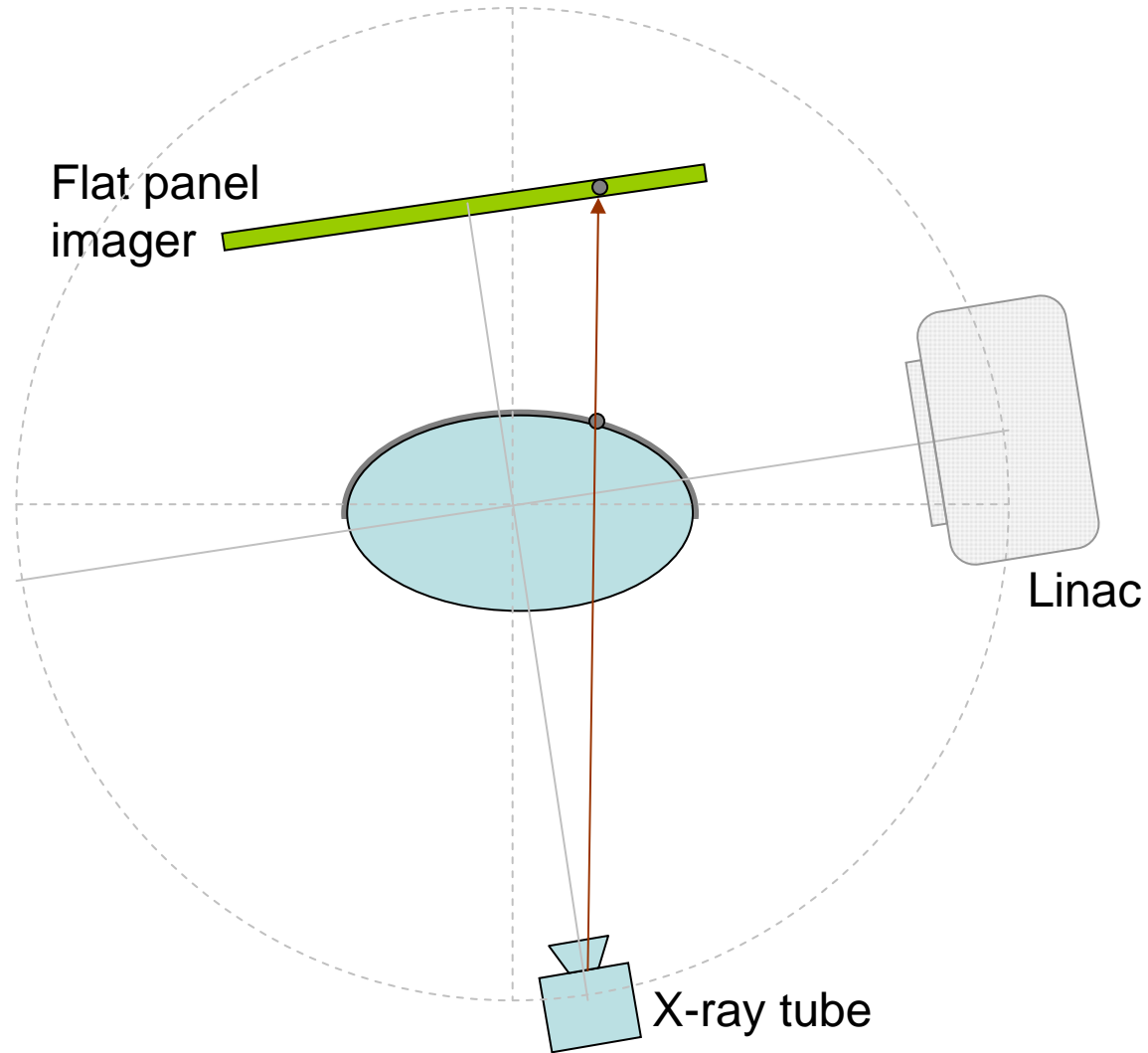
(a) CBCT projection image



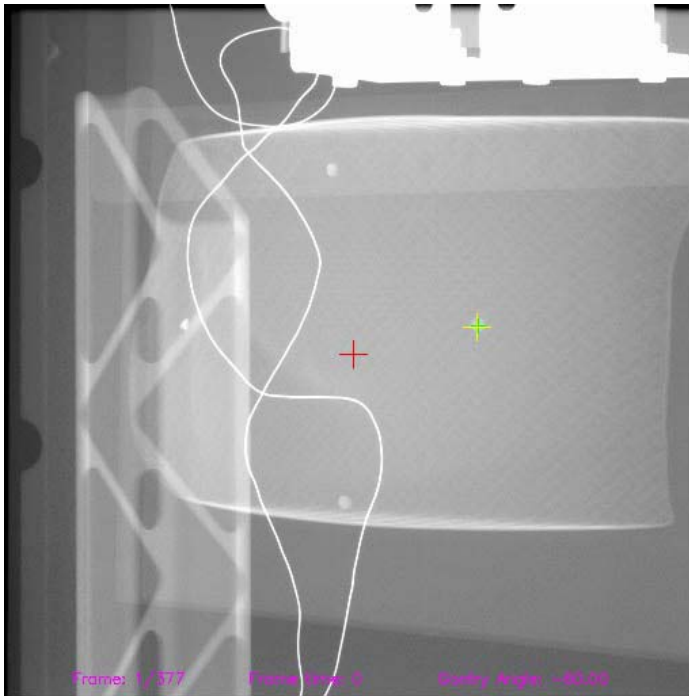
(b) Video frame from optical scanner

Can relate marker positions from optical surface to x-ray image coordinates

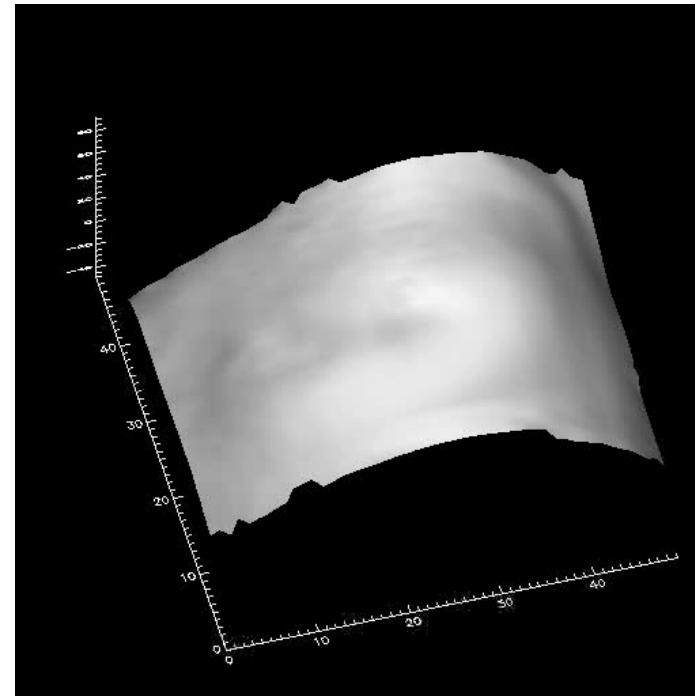
Projecting marker position into x-ray image coordinates



X-ray projections vs optical surface

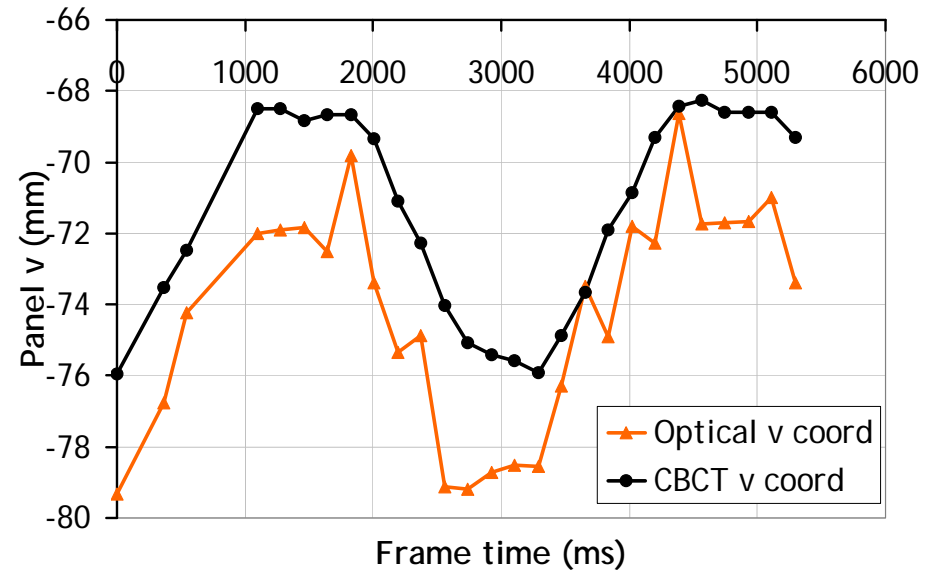
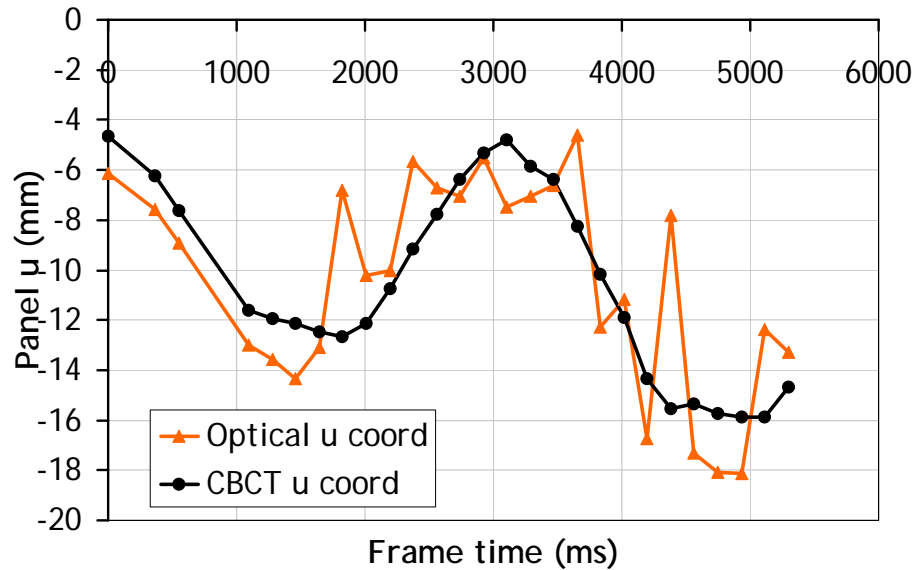


X-ray projections



Optical surface

Results



- Temporal synchronization good
- Optical data noisy (n.b. 25Hz vs 6Hz)
- 1-2mm offset in v

Summary

- Demonstrated first temporally synchronized optical surface sensor and kV CBCT acquisition
- Initial results show good agreement between systems
- Next extend to multi-camera optical system
- Allows augmentation of x-ray images with dynamic optical data

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