



VCU

School of Medicine

Optical Surface Imaging to Improve the Precision and Accuracy of Radiotherapy Delivery

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Disclosures

Grant for collision prediction work from Philips
Radiation Oncology Systems

Overview

- What is optical surface imaging?
- What is its current role in radiotherapy?
- Existing limitations

WHAT IS OPTICAL SURFACE IMAGING?

WHAT IS (OPTICAL) SURFACE IMAGING?



Photo source: Vision RT



Photo source: C-RAD



Photo source: C-RAD

Structured light + Triangulation

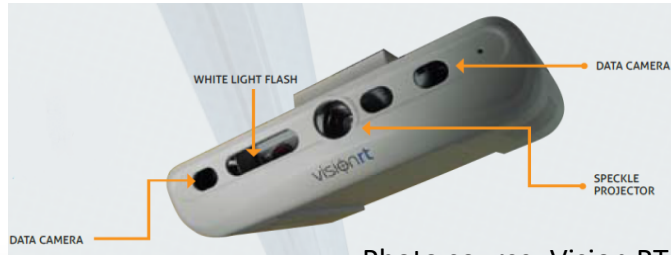
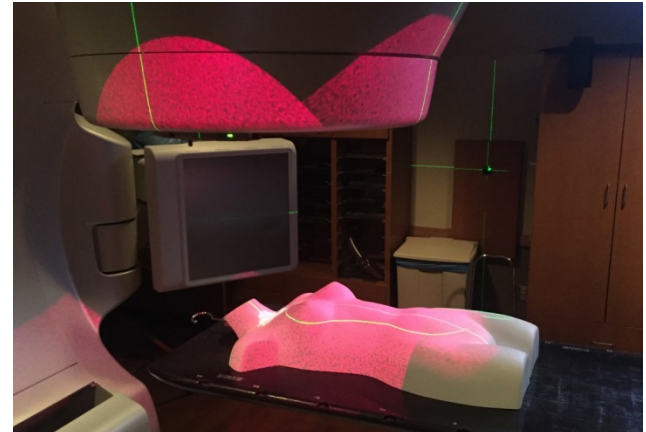


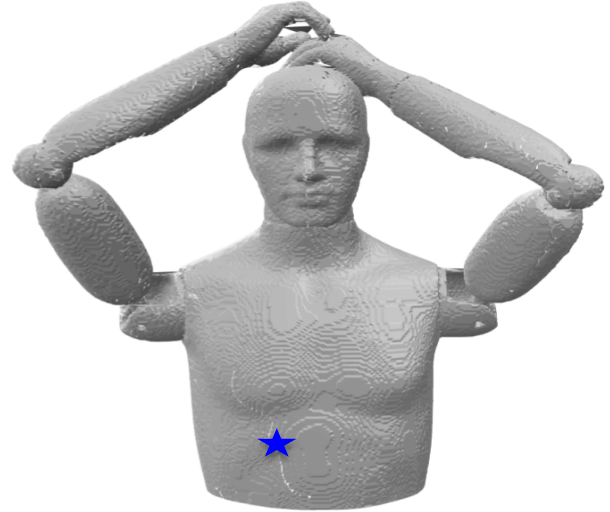
Photo source: Vision RT



Planning CT

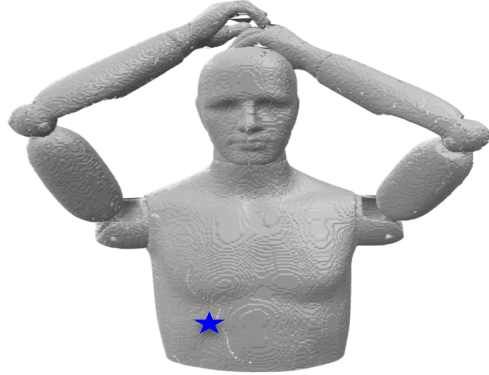


Treatment Plan

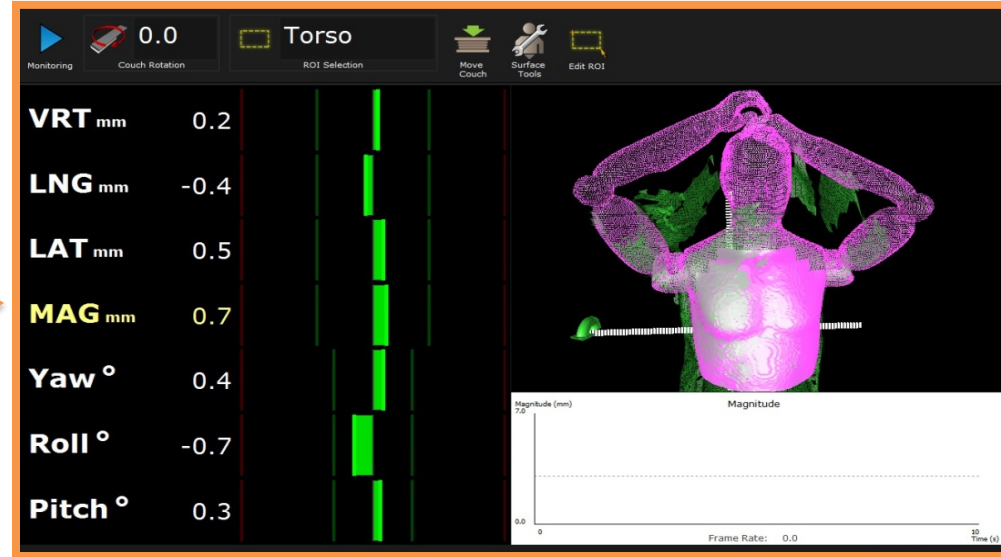


External Surface + Isocenter

Reference Surface



In-room, real time Surface



VRT LNG LAT
Yaw Roll Pitch

----- *Thresholds* -----

Positional adjustments
Beam Hold

WHAT IS ITS CURRENT ROLE IN RADIOTHERAPY?

Patient position at simulation
+
Location of treatment isocenter



Initial positioning aid



Intra-fraction monitoring

Patient position at simulation
+
Location of treatment isocenter



Initial positioning aid
(Replace tattoos + lasers)



Intra-fraction monitoring

Patient position at simulation
+
Location of treatment isocenter

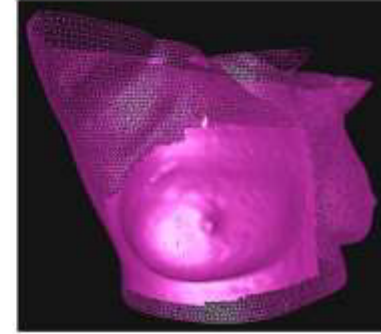
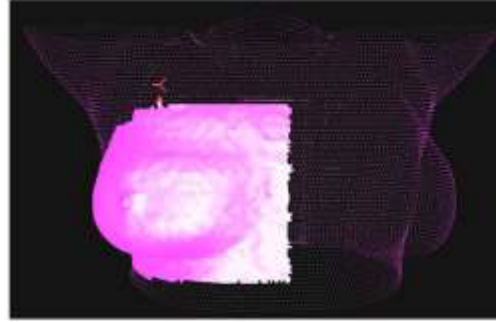


Initial positioning aid

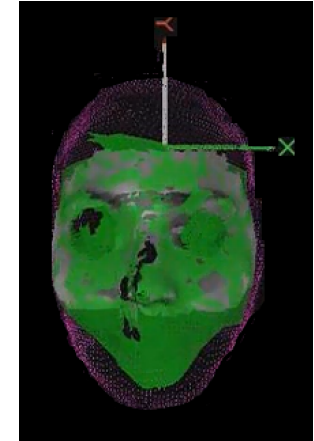


Intra-fraction monitoring

Deep Inspiration Breath Hold (DIBH) for left-sided breast patients



Stereotactic Radiosurgery (SRS)



Deep Inspiration Breath Hold (DIBH) for Left-Sided Breast Treatments

- DIBH → Heart sparing
- Voluntary breath-hold with Surface Imaging
- Automatic beam-hold possible
- Visual guidance available



Photo source: Conroy et al, JACMP 2016
(doi:10.1120/jacmp.v17i4.6188)

Utility of Deep Inspiration Breath Hold for Left-Sided Breast Radiation Therapy in Preventing Early Cardiac Perfusion Defects: A Prospective Study

(Zagar et al, IJROBP 2017)

- Evaluation of cardiac abnormalities post-DIBH RT with AlignRT
- 20 patients, pre-RT and 6-month post-RT SPECT scans
- No recorded perfusion or wall motion abnormalities

Stereotactic Radiosurgery (SRS)

- Real-time patient monitoring throughout treatment
- Open mask needed – patient selection!
- CBCT for initial positioning
- Patient monitoring and position correction

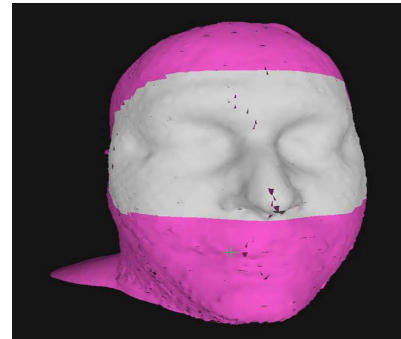
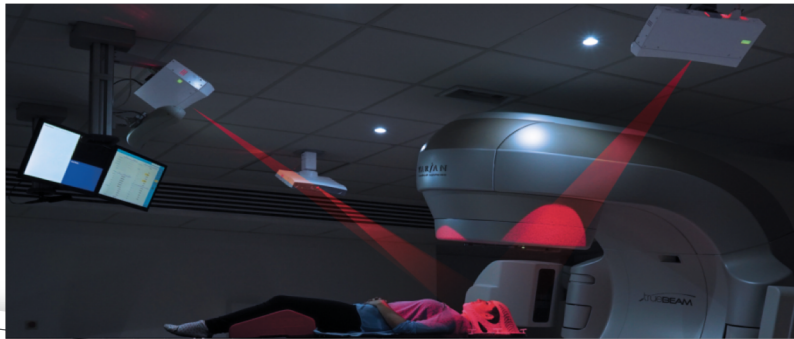


Photo source: VisionRT

Initial clinical experience with a frameless and maskless stereotactic radiosurgery treatment *(Cerviño et al, PRO 2012)*

Frameless, real-time, surface imaging-guided radiosurgery: update on clinical outcomes for brain metastases

(Pham et al, Transl Cancer Res 2014)

Initial clinical experience with surface image guided (SIG) radiosurgery for trigeminal neuralgia

(Paravati et al, Transl Cancer Res 2014)

Equivalent outcomes to framed and other
frameless techniques + increased patient
comfort

EXISTING LIMITATIONS

EXTERNAL Surface

Correlation with target?

Untracked internal motion?

Monitoring area of interest

Lack of topography

Shift affected by sheets, clothes, masks...

Tolerance settings and confounding motions

Surface Occlusion

Treatment machine

Non-ionizing radiation / no markers

Real time quantitative evaluation of patient movement



Improve radiation delivery accuracy and precision

Non-ionizing radiation / no markers

Real time quantitative evaluation of patient movement



Improve patient safety



Thank you