

# AlignRT in the Inbore Treatment Enviroment

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- 2 Varian Truebeam
  - 1 Varian Truebeam STx
  - 2 Varian Truebeam Edge
  - 1 Halcyon
  - 1 Bravos
- 
- CT Somatom GoOpen Pro
  - Siemens Magnetom Vida 3T
  - Siemens Biograph mCT

# Department on radiation Therapy Oulu University Hospital

- First AlignRT on Truebeam Edge from 2016
  - Stereotactic brain, brain, SBRT
- Second AlignRT on Truebeam STx from 2019
  - Stereotactic treatments, extremities...
- All linacs and Halcyon with AlignRT + SIM RT since 2022
  - Treatments with Inbore from 2023
  - All kind of patients

## Clinical Workflow:

- Patient setup with AlignRT
- Imaging with CBCT
- Monitoring with AlignRT

# Inbore in Halcyon at Oulu University Hospital

- Halcyon with InBore since 2022
- Patients: Prostate, Pelvis, Palliative Spine, Breast...
- DIBH Breast started from 03/2026
  - Manual beam hold
- Few DIBH Pancreas (stereotactic 3 fr) started recently
  - manual beam hold

# Our experiences with Inbore

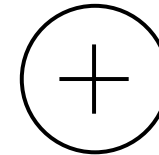
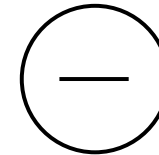
- Some issues with Inbore ring / inbore cameras

- Reference capture with "black holes"
- Some technical problems with program "Not responding...."

➡ New Inbore ring 2025      ➡ No problems

- Nothing blocks the cameras while treatment/imaging

- CBCT imaging with DIBH
- More stereotactic body treatments to Halcyon in the future?
  - Inbore system works well, fast imaging and treatments with Halcyon, 6DoF couch... -> why not?



# Master's Thesis (coming soon): Comparing AlignRT Inbore to Varian Identify on the Halcyon

- Oulu University Hospital: AlignRT Inbore
- Turku University Hospital: Varian Identify
- Measurements with phantom (Cirs Atom) on thorax and pelvis area
- Measurements with patients: 10 pelvis, 10 thorax patients with both SGRT systems
- Comparing camera accuracy (setup accuracy) and monitoring accuracy (ability to monitor movements)
  
- Some results to show from phantom data and patients ...
  - Pelvis area



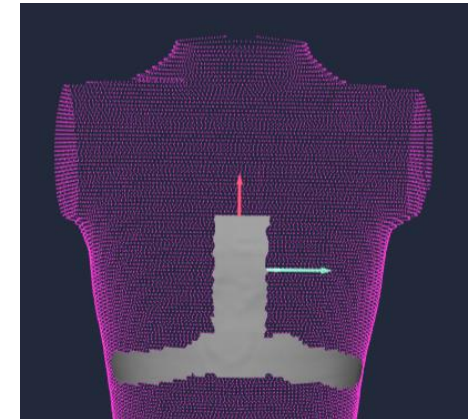
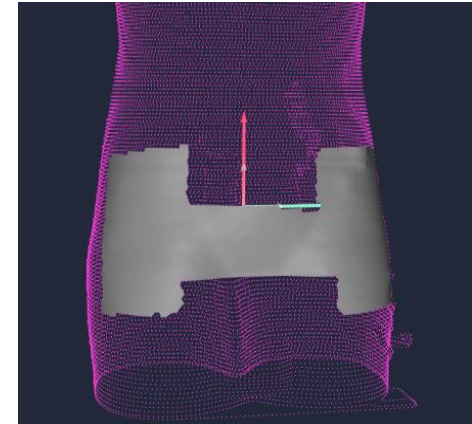
**VisionRT AlignRT InBore**



**Varian Identify**

# Phantom (Cirs Atom)

- Planning CT
- Treatment Plans: pelvis (and thorax)
- Setup with SGRT
  - 0 cm, 1 cm, 2 cm and 5 cm misaligned from "right position" in vrt, long, lat
- Imaging with CBCT
- Matching CBCT to CT (ROI : surface / the area SGRT cameras see)
- Comparing setup accuracy (SGRT camera data versus CBCT-shifts)
- Comparing monitoring accuracy (difference in SGRT camera data versus couch shifts)
  
- Each measurement repeated 10 times



# Monitoring accuracy (phantom, pelvis)

## AlingRT

- Vrt  $0,001 \pm 0,003$  cm
- Long  $0,010 \pm 0,006$  cm
- Lat  $0,003 \pm 0,005$  cm

0 cm

- Vrt  $0,000 \pm 0,000$  cm
- Long  $0,007 \pm 0,005$  cm
- Lat  $0,007 \pm 0,006$  cm

1 cm

- Vrt  $0,011 \pm 0,007$  cm
- Long  $0,033 \pm 0,031$  cm
- Lat  $0,020 \pm 0,015$  cm

2 cm

## Identify

- Vrt  $0,005 \pm 0,007$  cm
- Long  $0,013 \pm 0,005$  cm
- Lat  $0,007 \pm 0,006$  cm

- Vrt  $0,008 \pm 0,004$  cm
- Long  $0,016 \pm 0,011$  cm
- Lat  $0,007 \pm 0,006$  cm

- Vrt  $0,007 \pm 0,005$  cm
- Long  $0,013 \pm 0,011$  cm
- Lat  $0,005 \pm 0,005$  cm

# Setup accuracy (phantom, pelvis)

## AlingRT

- Vrt  $0,140 \pm 0,006$  cm
- Long  $0,017 \pm 0,009$  cm
- Lat  $0,034 \pm 0,009$  cm

- Vrt  $0,137 \pm 0,006$  cm
- Long  $0,013 \pm 0,014$  cm
- Lat  $0,030 \pm 0,006$  cm

- Vrt  $0,072 \pm 0,028$  cm
- Long  $0,076 \pm 0,057$  cm
- Lat  $0,051 \pm 0,027$  cm

0 cm

1 cm

2 cm

## Identify

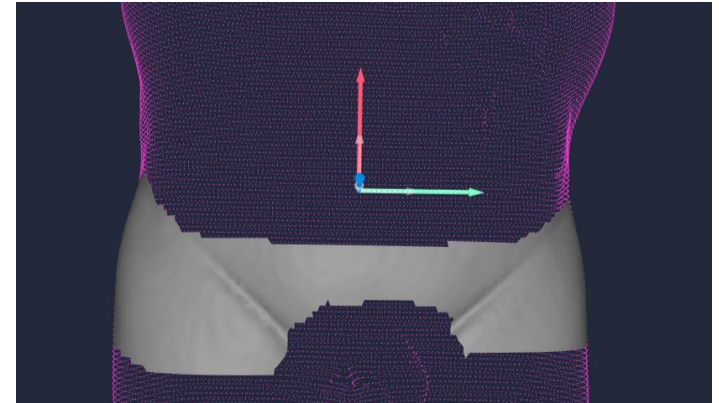
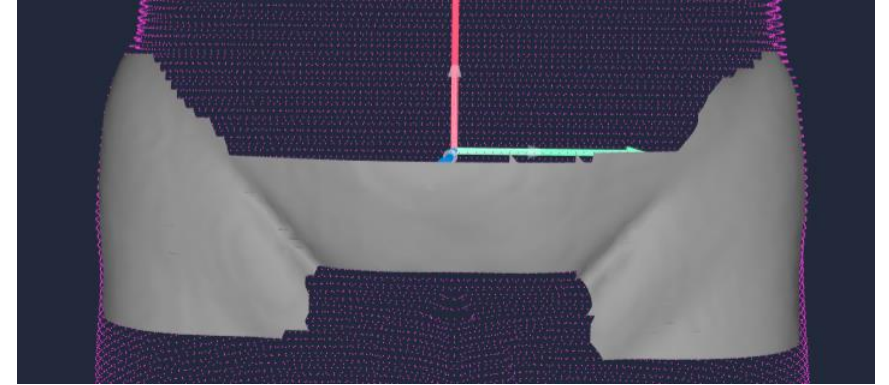
- Vrt  $0,018 \pm 0,006$  cm
- Long  $0,130 \pm 0,011$  cm
- Lat  $0,027 \pm 0,013$  cm

- Vrt  $0,024 \pm 0,013$  cm
- Long  $0,120 \pm 0,015$  cm
- Lat  $0,025 \pm 0,009$  cm

- Vrt  $0,030 \pm 0,011$  cm
- Long  $0,116 \pm 0,027$  cm
- Lat  $0,014 \pm 0,008$  cm

# Patients

- Planning CT
- Treatment Plans: pelvis and thorax (10 of both area)
- Patient setup with SGRT (setup cameras)
  - "typical ROI"
- Moving patient into the bore
  - Reporting SGRT camera values ("treatment cam1")
- Imaging with CBCT and matching by bony anatomy/gold fiducials
- Making couch shifts
  - Reporting SGRT camera values ("treatment cam2")
- Comparing setup accuracy
  - "Treatment cam1" versus Online matched values
  - "Treatment cam2" -value
- Comparing monitoring accuracy (difference in camera values versus couch shifts)



# Monitoring accuracy (patients, pelvis)

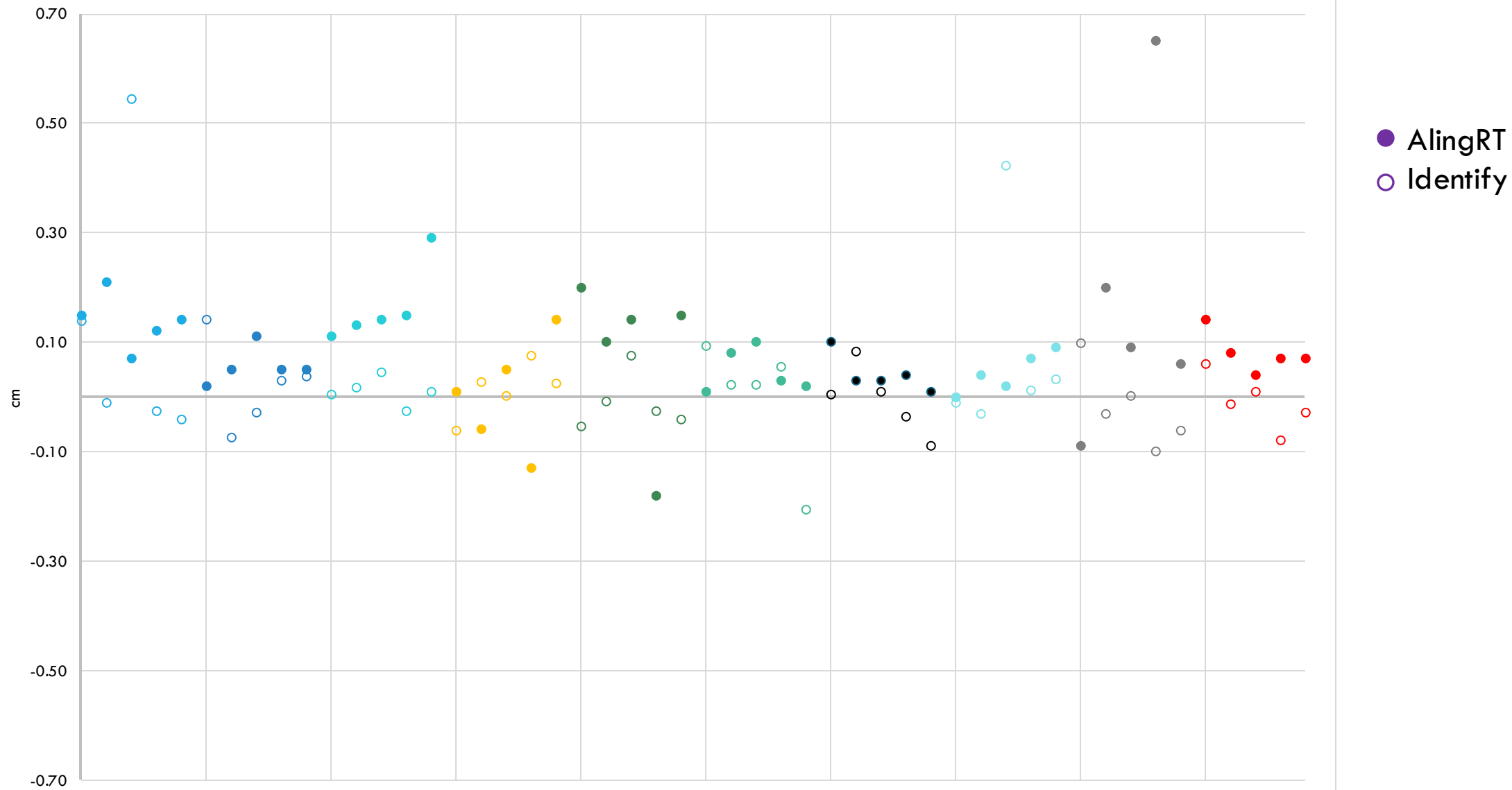
## AlingRT

- Vrt  $0,10 \pm 0,10$  cm
- Long  $0,12 \pm 0,14$  cm
- Lat  $0,06 \pm 0,05$  cm

## Identify

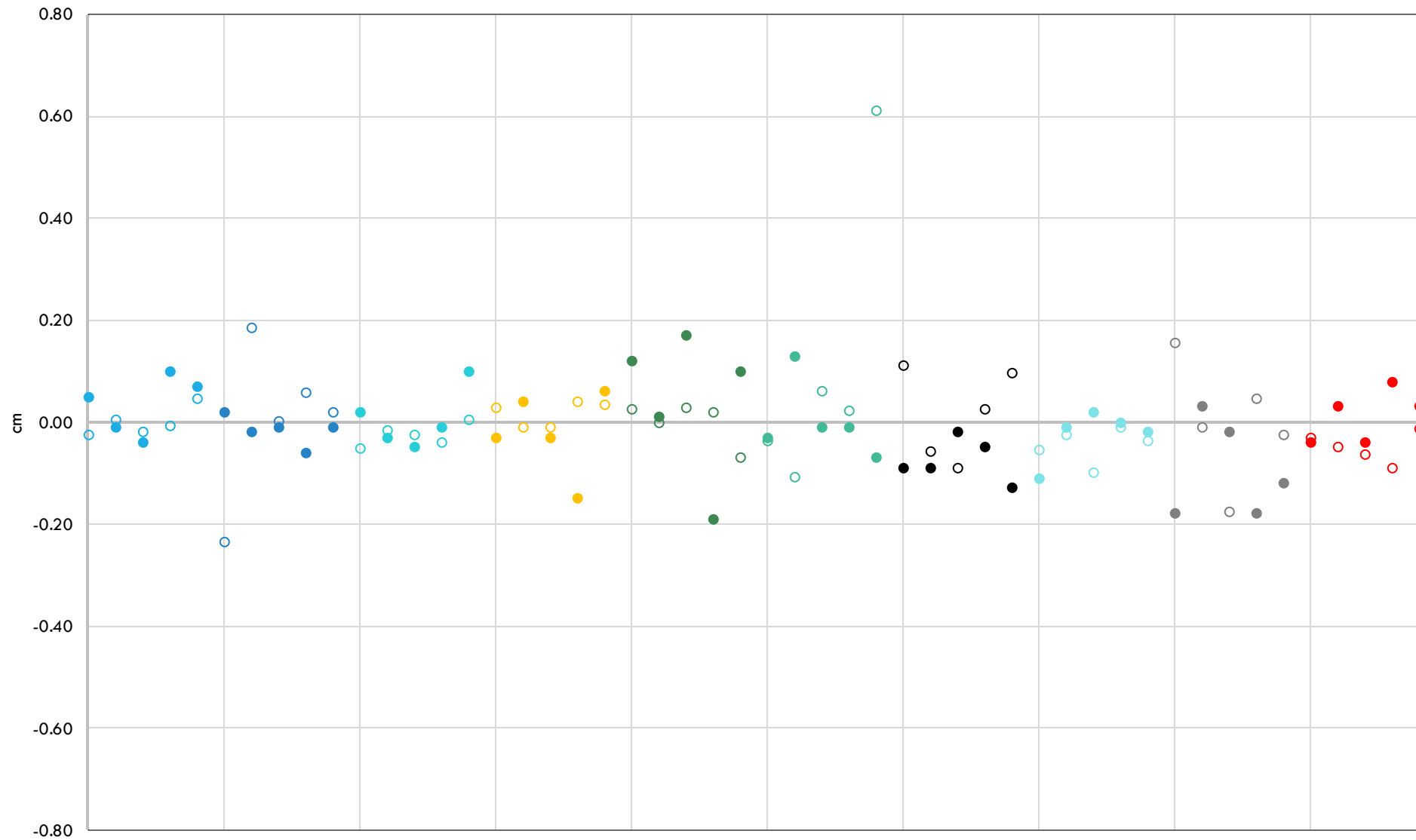
- Vrt  $0,06 \pm 0,10$  cm
- Long  $0,08 \pm 0,21$  cm
- Lat  $0,06 \pm 0,09$  cm

Monitoring accuracy vrt





# Monitoring accuracy lat



- AlingRT
- Identify

# Setup accuracy (patients, pelvis)

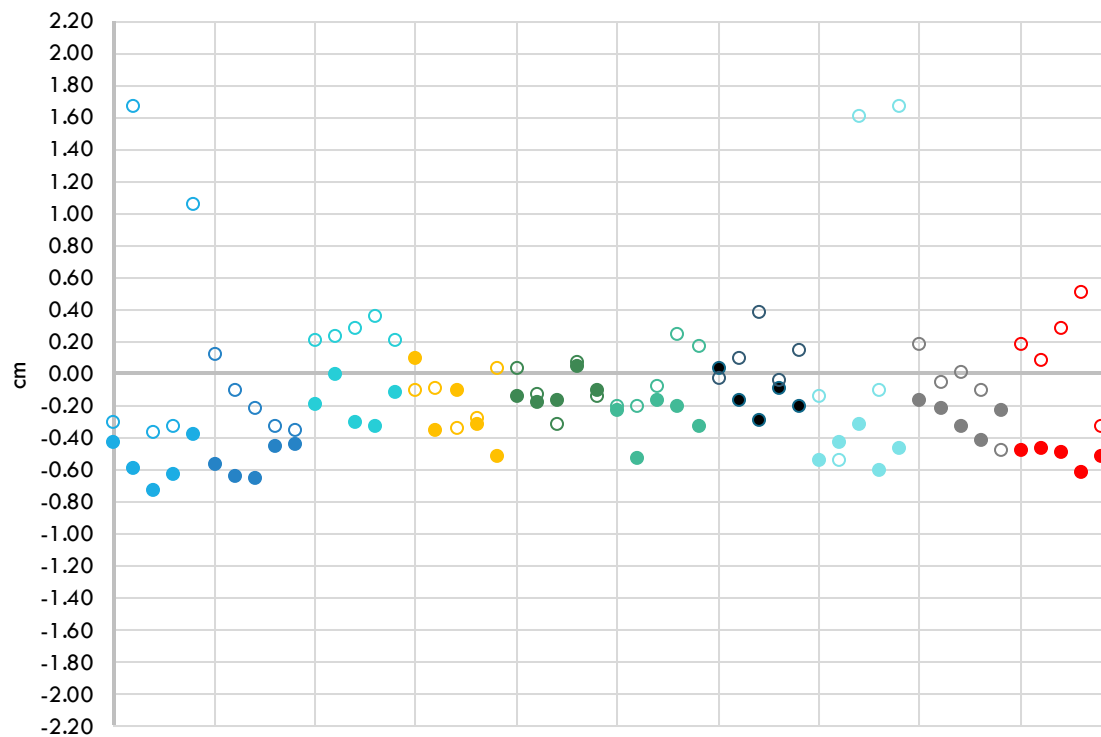
## AlingRT

- Vrt1  $0,34 \pm 0,19$  cm
- Vrt2  $0,28 \pm 0,17$  cm
- Long1  $0,41 \pm 0,39$  cm
- Long2  $0,39 \pm 0,38$  cm
- Lat1  $0,13 \pm 0,10$  cm
- Lat2  $0,12 \pm 0,12$  cm

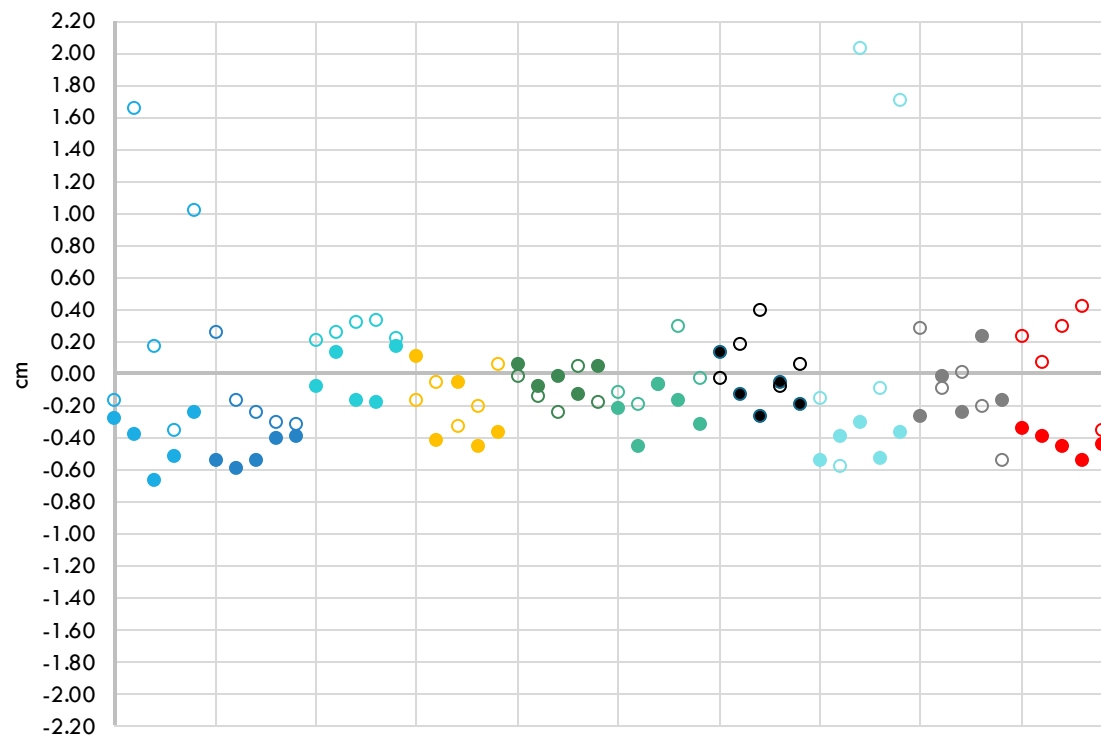
## Identify

- Vrt1  $0,31 \pm 0,38$  cm
- Vrt2  $0,32 \pm 0,41$  cm
- Long1  $0,58 \pm 0,63$  cm
- Long2  $0,58 \pm 0,61$  cm
- Lat1  $0,30 \pm 0,26$  cm
- Lat2  $0,29 \pm 0,26$  cm

Setup accuracy vrt1  
(SGRT shift - IGRT shift)

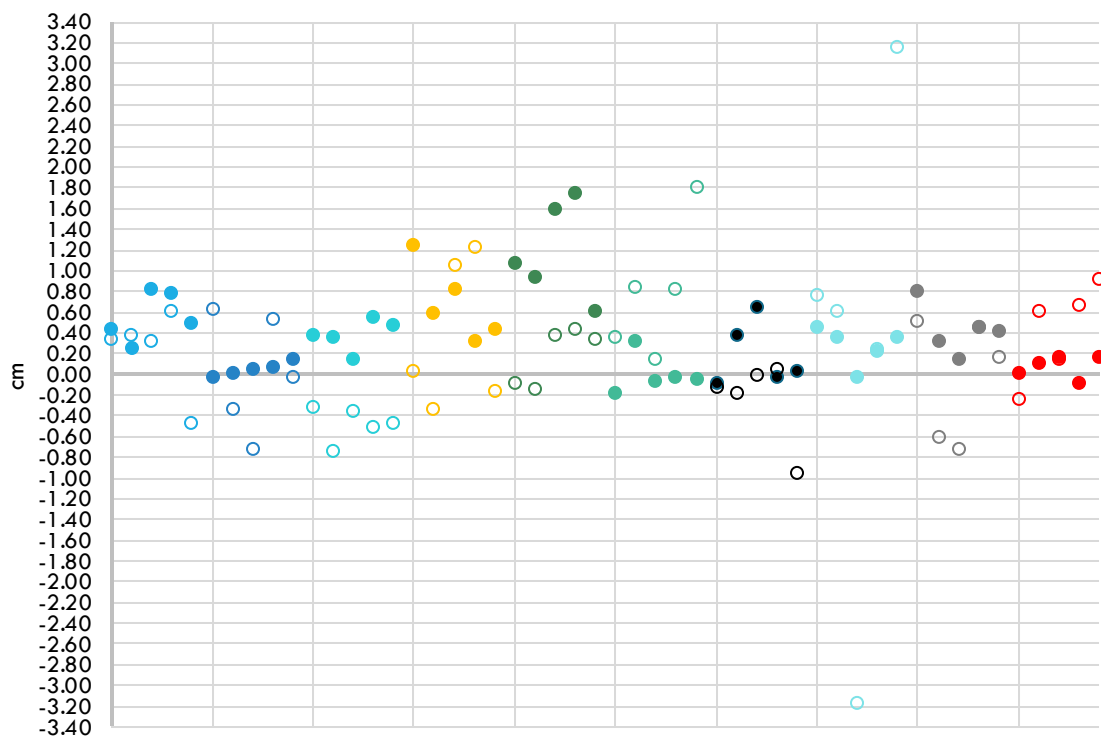


Setup accuracy vrt2  
(SGRT value after CBCT match)

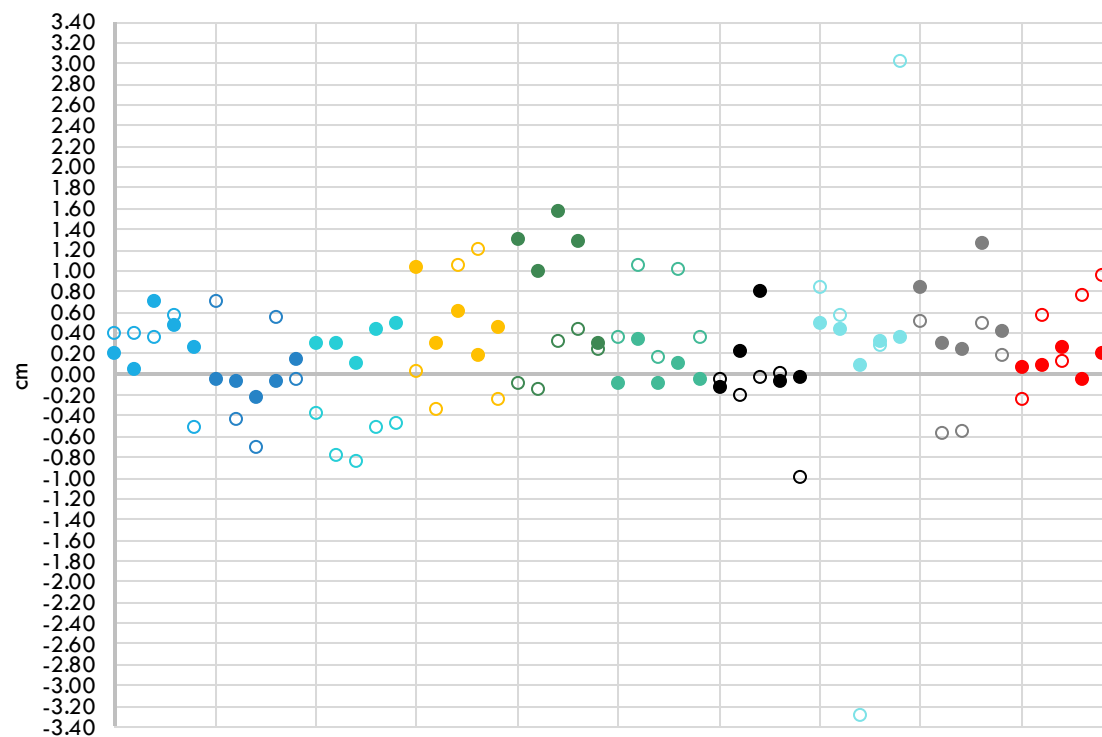


- AlingRT
- Identify

Setup accuracy long1  
(SGRT shift - IGRT shift)

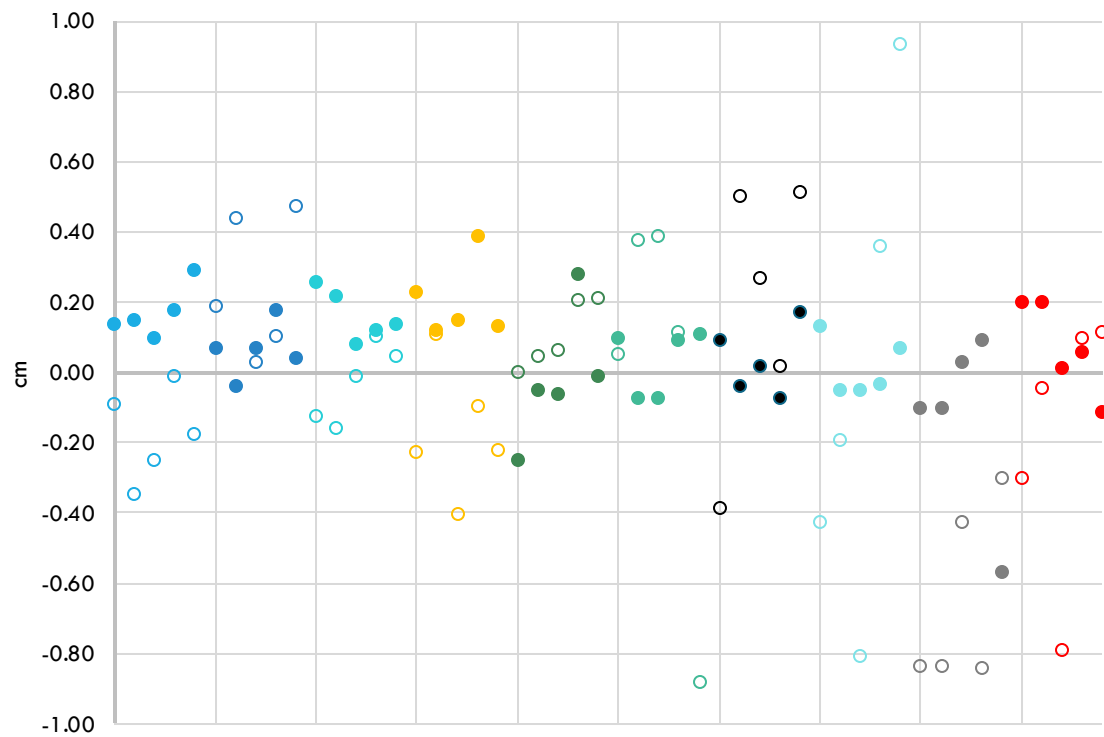


Setup accuracy long2  
(SGRT value after CBCT match)

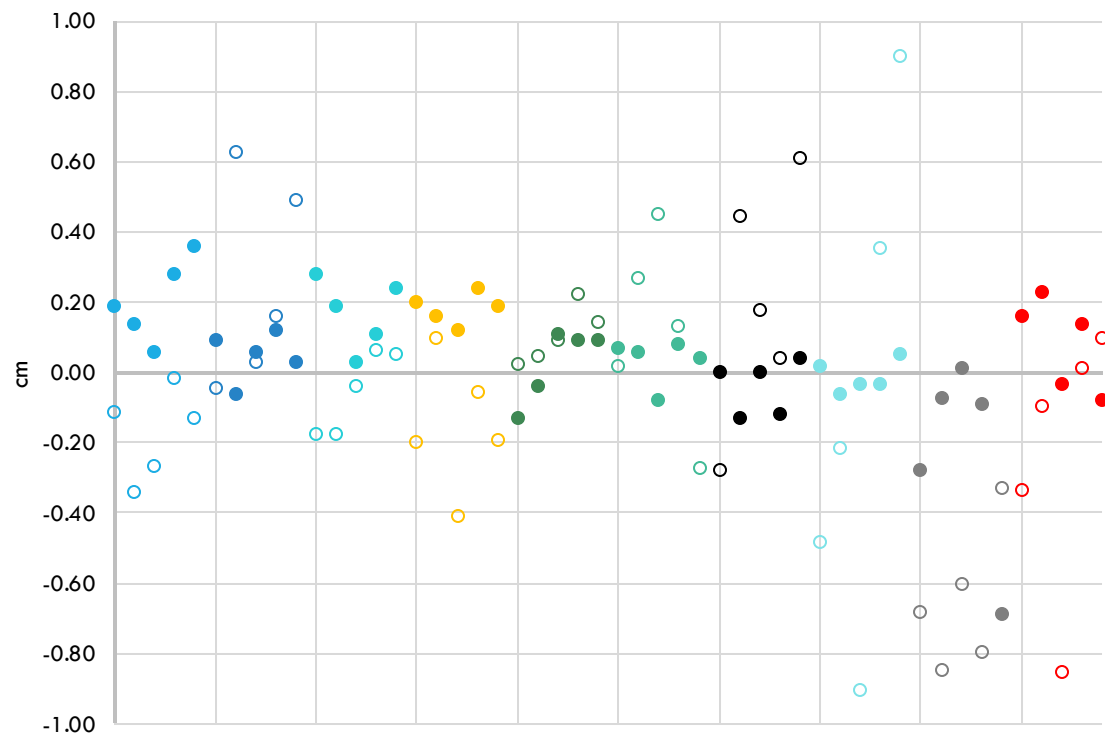


- AlingRT
- Identify

Setup accuracy lat1  
(SGRT shift - IGRT shift)



Setup accuracy lat2  
(SGRT value after CBCT match)



- AlingRT
- Identify

# Discussion

- Similar results with phantom measurements
  - Identify wasn't able to give any camera values when 5 cm misalign was done
- More patient data needed!
  - Quite similar results with patient data
  - Monitoring accuracy  $\leq 1$  mm (patient data) versus  $< 0,1$  mm (phantom data)
    - Movements of patients affect this!
  - Setup accuracy quite similar, with bigger SD at Identify
    - Setup accuracy 1- 6 mm for patients versus  $< 1$  mm for phantom
    - This study used matches done in patient treatments (gold fiducial matc/ bony anatomy match)
      - Should be re-matched offline and focus the match to the surface!

# Conclusion

- We are quite happy to use AlingRT Inbore
- Study: There's no need to change AlignRT InBore to Varian Indentify

THANK YOU!  
QUESTIONS

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