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3D surface image guided based DIBH clinical implementation

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Outline

- System overview
  - AlignRT—we focus on this system
  - C-rad
- Clinical workflow
- Commissioning and routine quality assurance
- Practical tips

2

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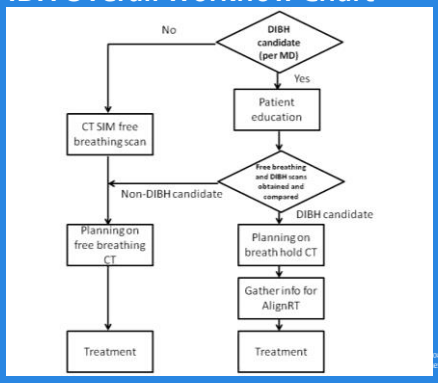
AlignRT System in Treatment Room

Surface Matching Algorithm

- Gating based on Real-Time Deltas (RTD)
- Real time register Verification surface to Reference surface to calculate
  - Translational displacements
  - Rotational displacements

RTD

DIBH Overall Workflow Chart



Patient Selection—Physician Consult

- Left sided breast cancer patients
  - Tangents, Tangents + SCV field
  - IMRT and VMAT
  - Separate IMN field is challenging
- Age is important—younger patients likely to live longer and therefore have time to manifest RT-induced cardiac disease
- Can patient do breath hold?
  - Talk to patient to see if she can follow instructions
  - Pay attention to patients' other comorbid conditions

Patient Education

- **Without patient education**
  - They did not know what will happen in the treatment room—generated unnecessary anxiety (afraid of making mistakes)
  - One patient asked questions for 10 minutes while on the treatment table
- **With patient education**
  - Patients go through what they expected—less worries, more cooperative
  - Less questions asked in the treatment room
  - Patients appreciate more

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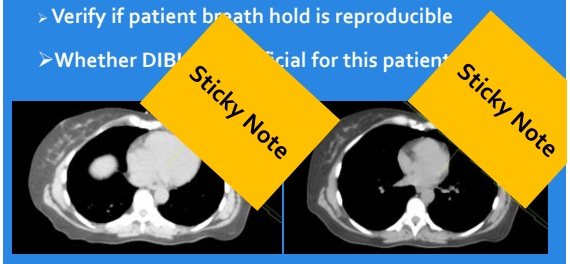
AT CT SIM

- Verify if patient breath hold is reproducible
- Whether DIBH is beneficial for this patient



Free Breathing | Breath Hold

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Patient Setup and Treatment

Patient Setup Tips

- Check breath hold light field every day
- Trace the border of the light field
  - Easier for the following day setup
  - Physicians can check even in the exam room
- Record daily couch shift from the free breathing tattoos

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Clinical experience with 3-dimensional surface matching-based deep inspiration breath hold for left-sided breast cancer radiation therapy

Xiaoli Tang, PhD, Timothy M. Zagar, MD, Eric Bair, PhD, Ellen L. Jones, MD, David Fried, BS, Longzhen Zhang, MD, Gregg Tracton, BS, Zijie Xu, MS, Traci Leach, BS, Sha Chang, PhD, Lawrence B. Marks, MD

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- Analyze PORT films to assess patient setup accuracy
- When the RTD threshold is set to 3 mm
- 50 patients

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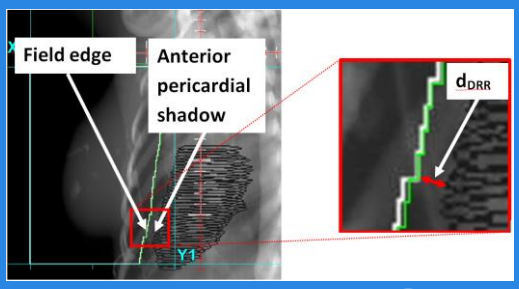
Measurement of d_{DRR}



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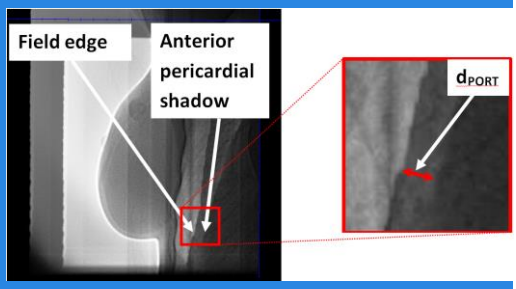
Measurement of d_{PORT}



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Comparison between the d_{PORT} and d_{DRR} and corresponding statistics

Measurements	|Systematic uncertainties| (cm)				Systematic uncertainties (cm)				Random uncertainties (cm)			
	Mean	Max	Min	σ_s	Mean	Max	Min	σ_s	Mean	Max	Min	σ_r
All patients	0.20	1.22	0	0.23	-0.07	0.67	-1.22	0.30	0.19	0.84	0	0.17

The setup uncertainty is 2 mm

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Commissioning

- Safety interlock
- System stability/drift check
- Couch shift accuracy and constancy tests
- Gating function check
- Gated beam output within 2% of baseline?
- End-to-End test
  - Check I/O, iso location, skin rendering, and patient name and ID

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Accuracy Test Basics

1. Setup the phantom
2. Capture a reference image
3. Move couch to a known position
4. Apply AlignRT to capture a surface image
5. Calculate shift
   - Use either real-time deltas or "move couch"
6. AlignRT shift should match the known couch shift
   - Less than 1mm and 1°difference for translational and rotational displacement

16

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Couch Shift Constancy Check

- AlignRT should give the same result at different gantry angles
- Fluctuation should be less than 1mm and 1° for translational and rotational displacement
- Specially when an entire camera pod is blocked, the system should give the consistent result

17

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Generate Protocols

- Design your own clinical protocols with the entire team
  - Physicians: patient selection criteria
  - Nurses: patient education
  - Physicists: oversee the system, and do physics prep
  - Dosimetrists: different constrains for planning
  - Therapists: ultimate users to treat patients
- Communicate with the entire team! It's a team effort!

18

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Set QA Program

- Daily QA
- Monthly QA
- Patient specific QA—ROI selection reasonable?

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Practical Tips

- Commissioning and preparation
  - 1 physics FTE
  - Team work is important—recommend to learn the system as a whole team and build he program
- Routine QA and maintenance
  - ¼ - ½ FTE depends on how busy the program is

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Conclusion

- We have learned the AlignRT system and how to implement it to the clinic
- We have also learned the QA programs needed to maintain the DIBH programs

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