

2.Uluslararası Katılımlı RADYOTERAPİ Kongresi ve Eğitim Seminerleri



C-RAD

CATALYST HD

SENTINEL

**Yüzeyel Görüntü Kılavuzluğunda
Radyoterapi (S-IGRT)**

Doç. Dr. Yiğit Çeçen

23 Nisan 2019



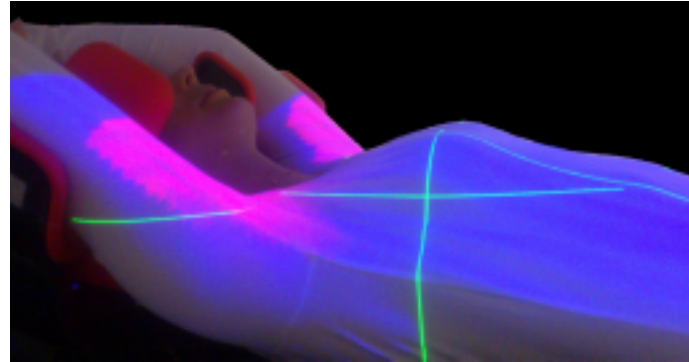
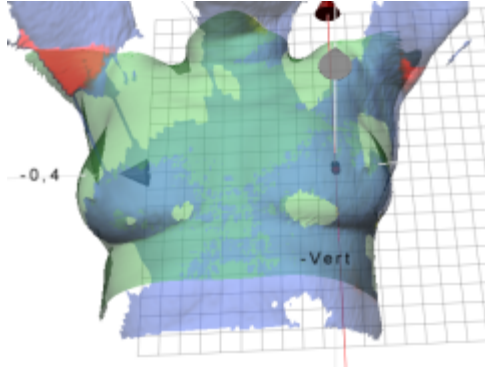
Görüntü ile Hasta Takibi

- 3 noktalı lazer ile pozisyon verme
- 2 Boyutlu MV görüntü
- IGRT (Görüntü Kılavuzluğunda RT)
 - Konik Hüzmeli BT – tedavi öncesi
 - Ortogonal X-ışını ile
 - MRG ile

Yüzeyel Görüntü Kılavuzluğunda Radyoterapi (S-IGRT)

Klinik Avantajlar

- ✓ Doz yok
- ✓ *Invaziv değil*
- ✓ *Marker yok*
- ✓ *Günlük iş akışına katkı*



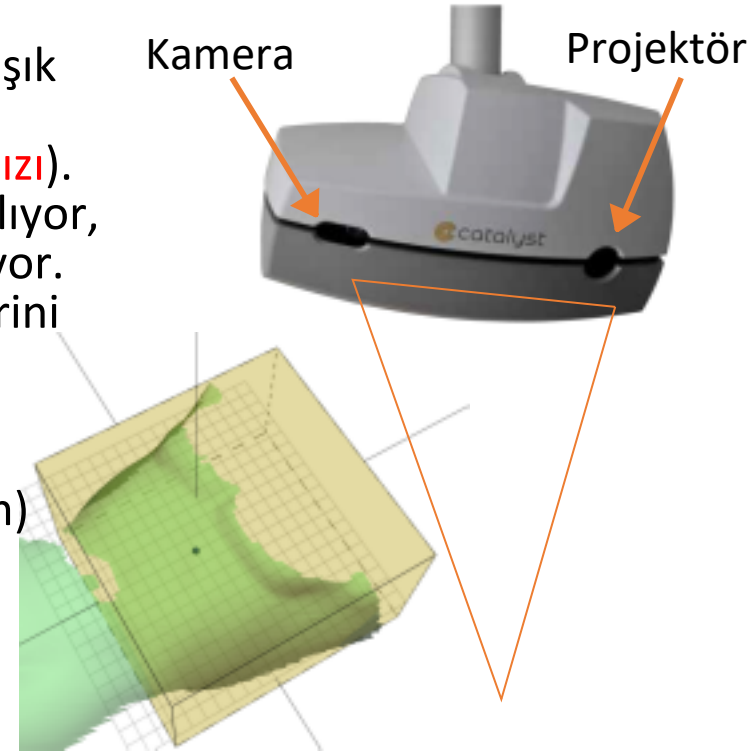


catalyst HD

Courtesy image from UTHSC, USA

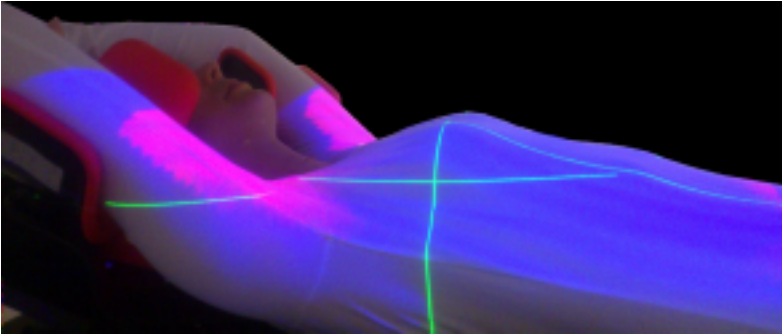
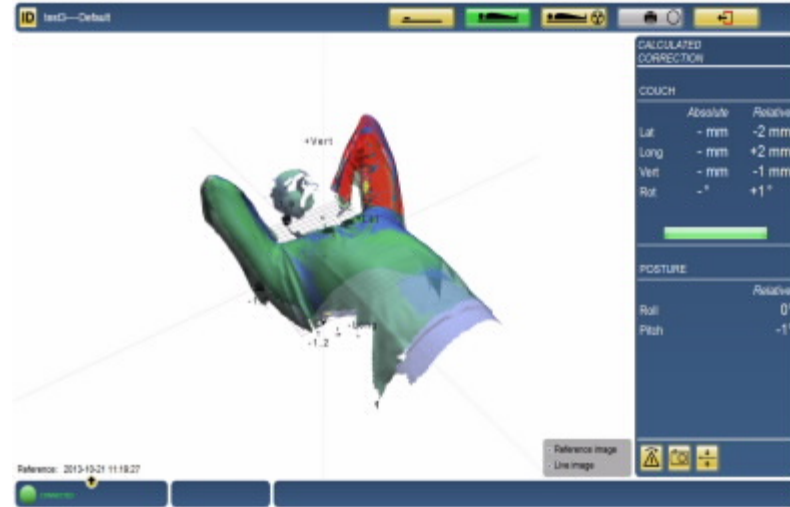
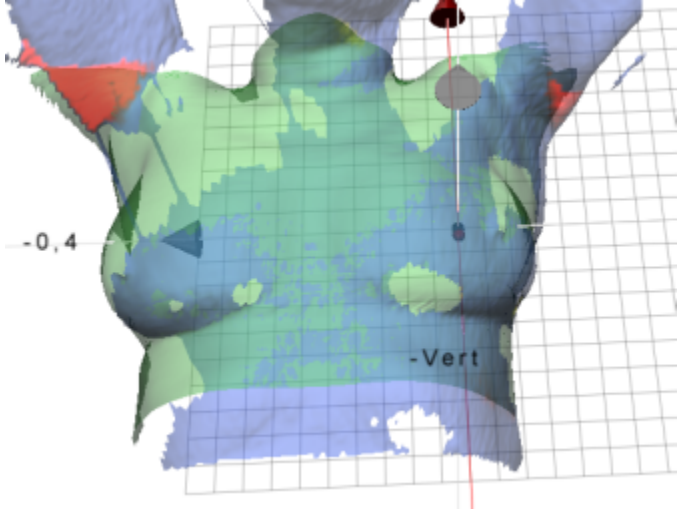
Catalyst – Renkli Projeksiyon

- Projektör içindeki LEDler çeşitli dalga boylarında ışık gönderiyor.
- 405 nm (**mor-mavi**), 528 nm (**yeşil**), 624 nm (**kırmızı**).
- **Mor-mavi** ışık tarama ve ölçüm yapmakta kullanılıyor, bir monokrom CCD kamera tarafından kayıt alınıyor.
- **Yeşil** ve **Kırmızı** LEDler yüzeyde tutarsızlıkların yerini belirtiyor. İlk ölçüm ile anlık ölçümün + ya da – pozisyon farkını belirtiyor.
- Toplam tarama alanı (x y z) (800 x 1300 x 700 mm)
- Tarama hızı: 200 kare / saniye*
- Pozisyon kesinliği: 0,5 mm içinde*
- Hareket algılama: 0,5 mm içinde*
- Ölçümlerin tekrarlanabilirliği: 0,2 mm*
- Uzun dönem stabilitesi: 0,3 mm*



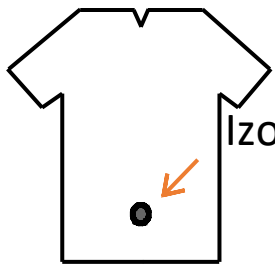
Tarama hacmi;
800 x 1300 x 700 mm (xyz)

Renkli Projeksiyon

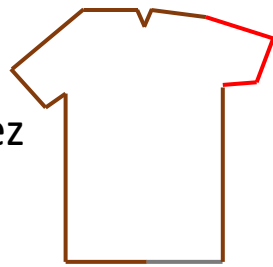


- Tüm vücut pozisyonlama
- Günlük rutine tam entegre
- Tedavi masasıyla bağlantı kurarak pozisyon farklarını ayarlama

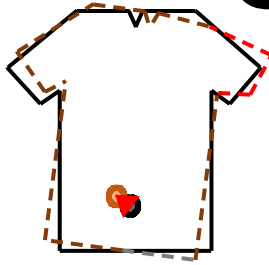
Rijit Olmayan (Non-rigid) Algoritma



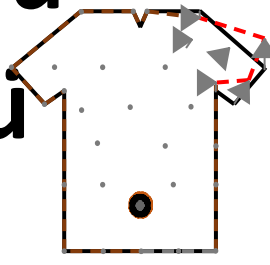
Referans
Görüntü



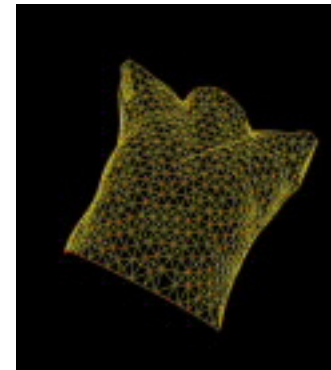
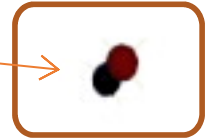
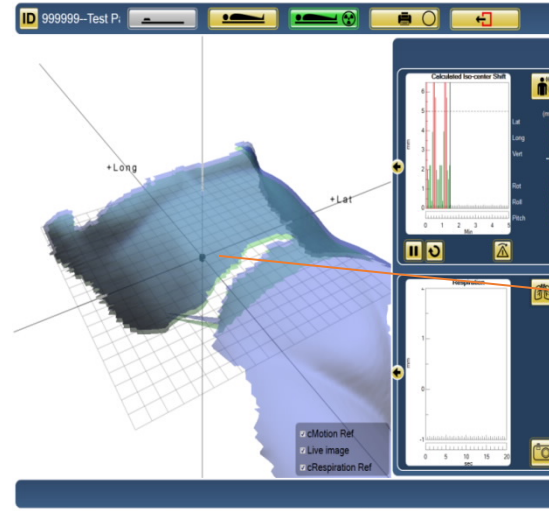
**Anlık
Görü
ntü**



Rijit
Pozisyonlama



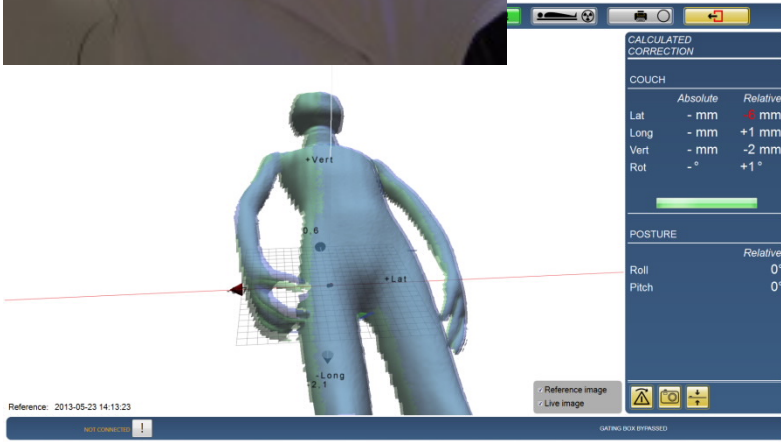
**Rijit
Olmay
an**



LINAK RT-ODASI



- Geniş tarama alanı
- Bir ya da üç kamera (Catalyst HD)
- Modül Bazlı sistem



C-Rad Catalyst 3 Modül



Tedavi Öncesi Hasta Pozisyonu



Tedavi Sırasında Hareket Takibi



Nefes Takibi

4D CT

Sentinel 4D CT
BT odasında



Catalyst/HD
LINAK odasında



Çözüm Desteği

 Elekta

 VARIAN
medical systems

 TomoTherapy

 Iba



SETUP AND
POSITIONING
OF PATIENTS



INTRA-FRACTION
MOTION DETECTION

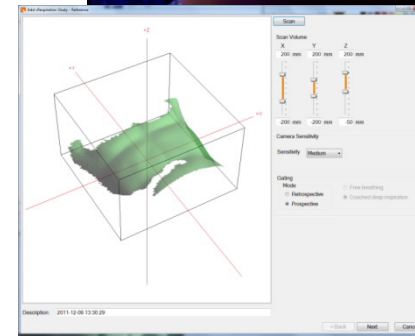


RESPIRATORY
GATING



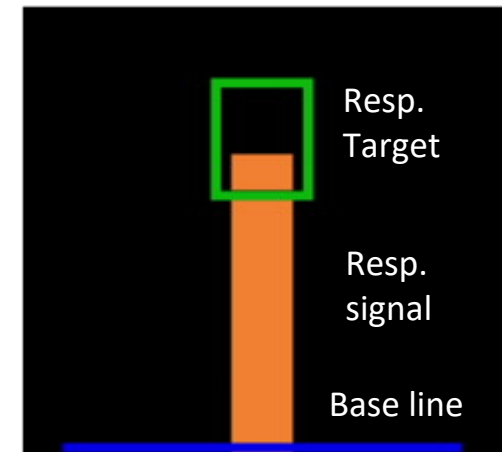
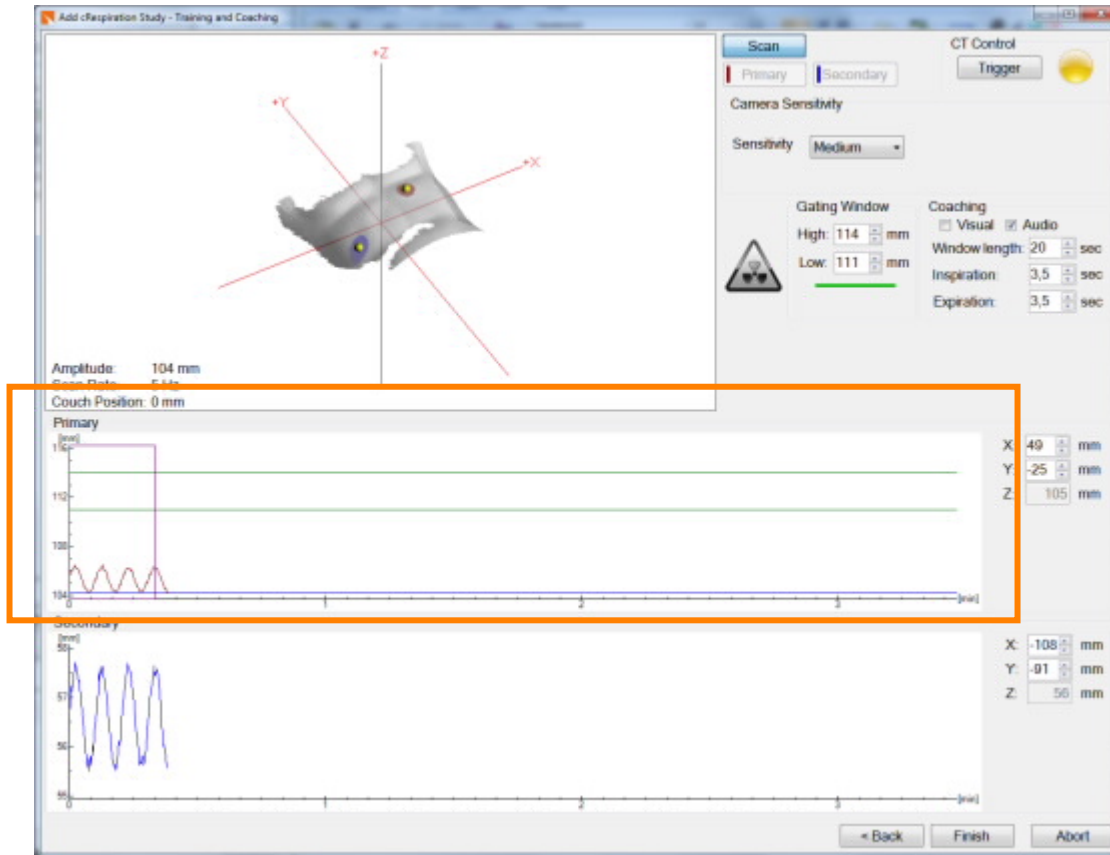
4D CT

- Hasta üzerinde markır yok
- Çoklu takip noktası belirleme
- Hastaya Sesli/görüntülü geri bildirim
- *Prospektif* (Derin Nefes Alıp Tutma) modu
- Retrospektif (Serbest nefes) modu

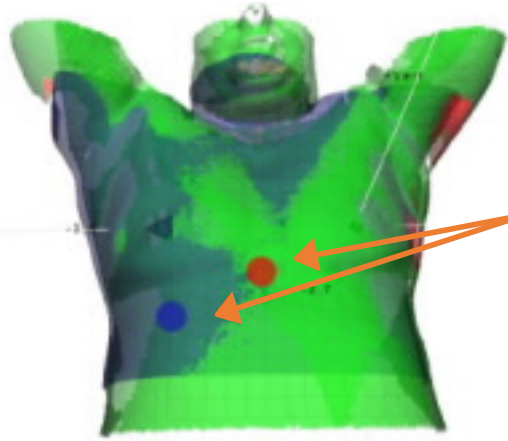


Derin Nefes Alıp Tutma

Deep Inhalation breath hold (DIBH)

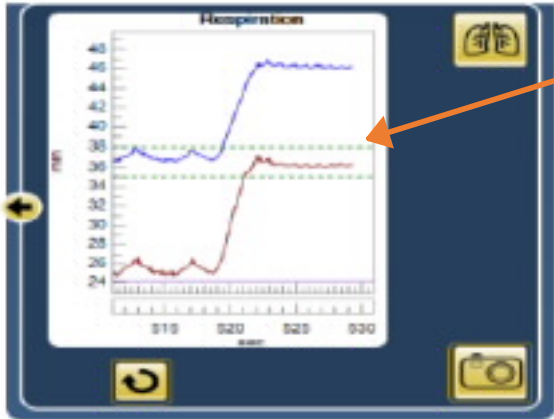


Nefes Takibi



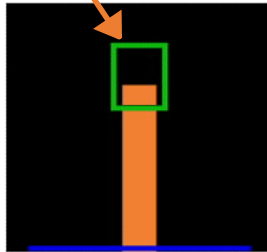
Sanal takip noktaları

- Birçok sanal takip noktası belirlenebilir
 - Özel gözlük: Ses/görüntü
 - LINAK ile haberleşme
 - Otomatik ışın kesme
- Hastaya göre MU belirleme

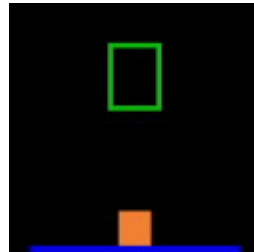


Monitör

Takip penceresi



Nefes tutma

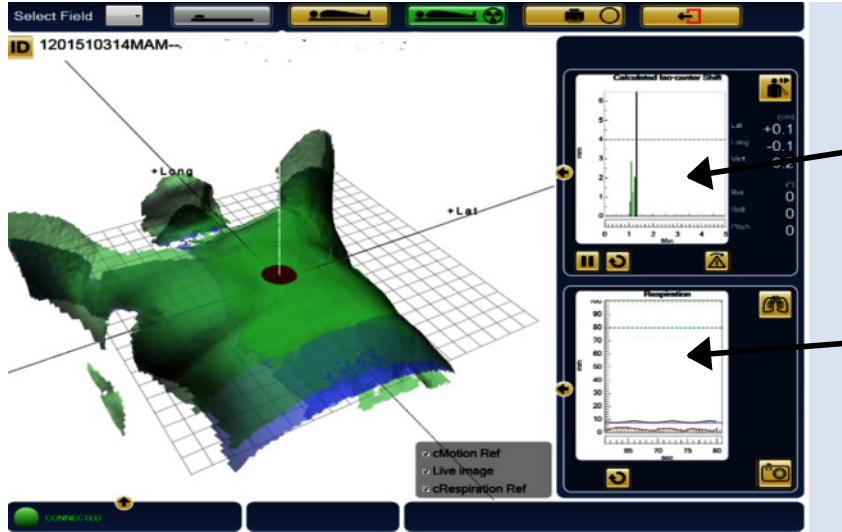


Nefes verme



Gözlük

3) Nefes Takibi- DIBH

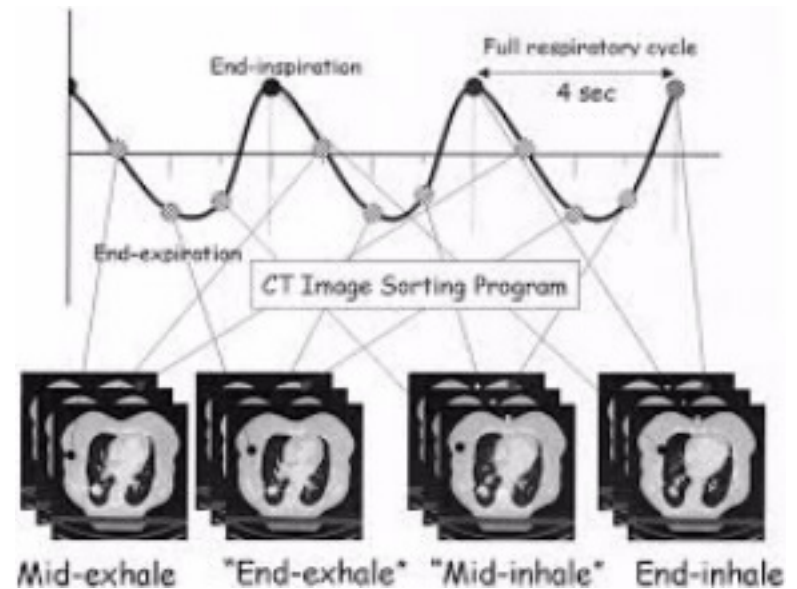
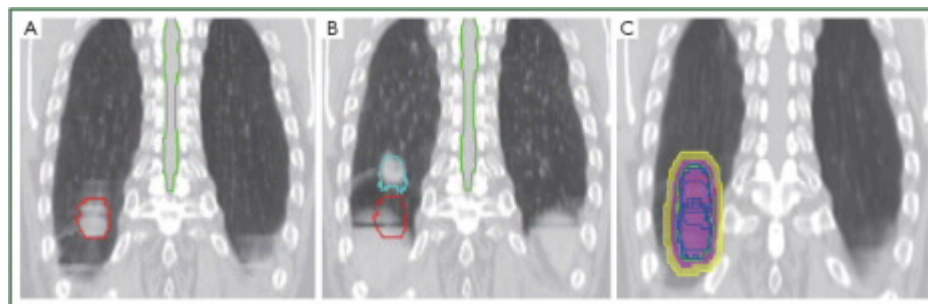
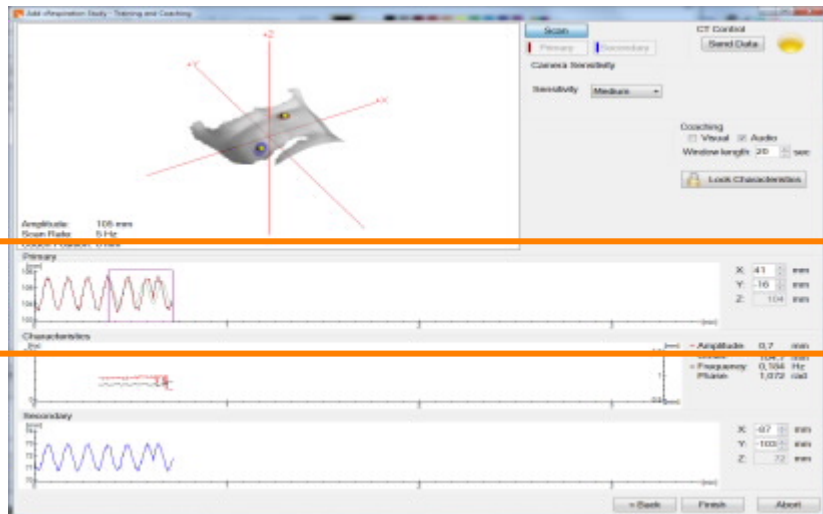


Anlık hareket takibi

Nefes takibi



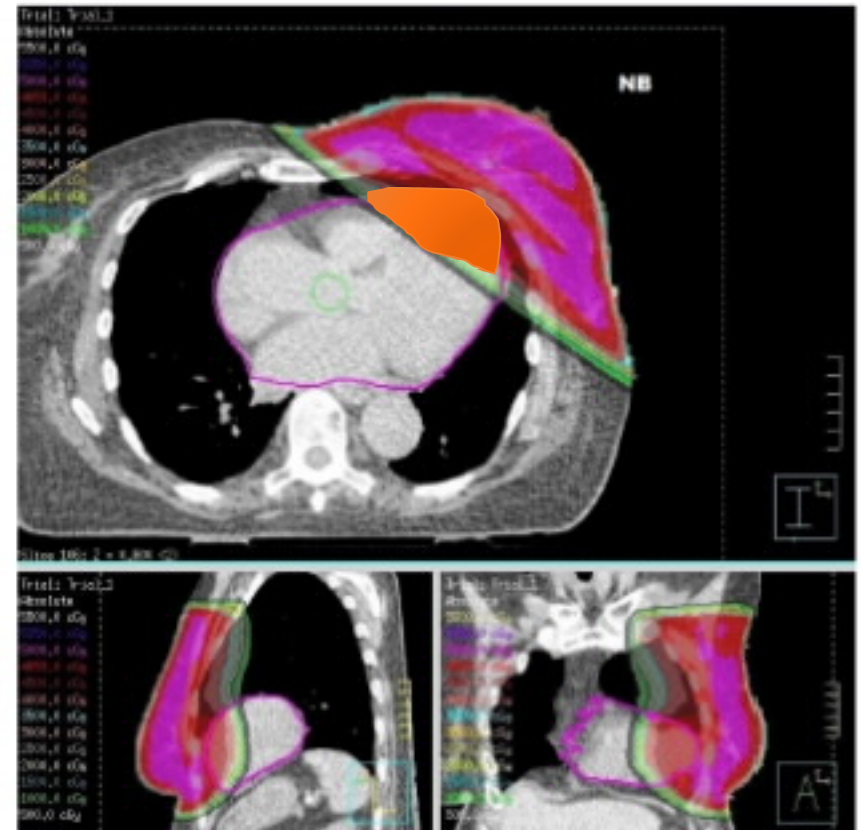
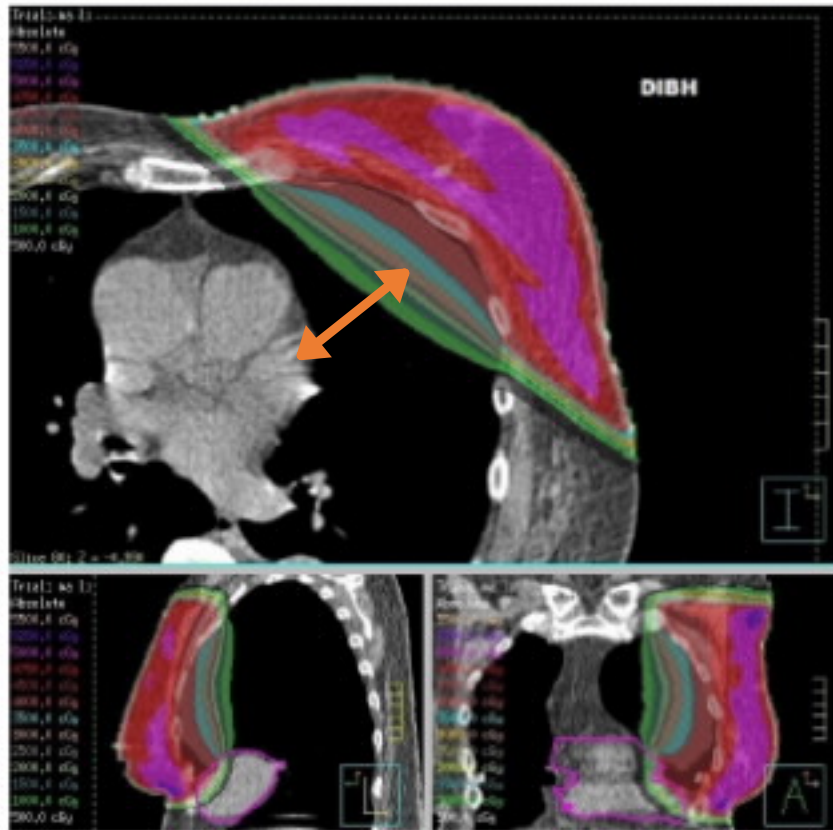
- Hasta eğitilir / gözlük var
- Nefes takibi
- Yüzeyel hareket takibi



Dosimetrical comparison between Plans in DIBH and NB

DIBH Derin Nefes Alıp Tutma

(NB) Serbest Nefes



1) Tedavi Öncesi Hasta Pozisyonu



2) Tedavi Sirasında Hareket Takibi



**Motion detection and
IGRT correction**

 C-RAD

3) Nefes Takibi

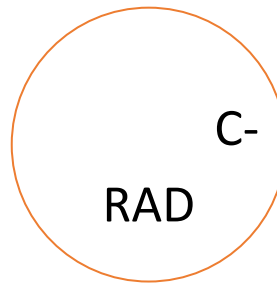
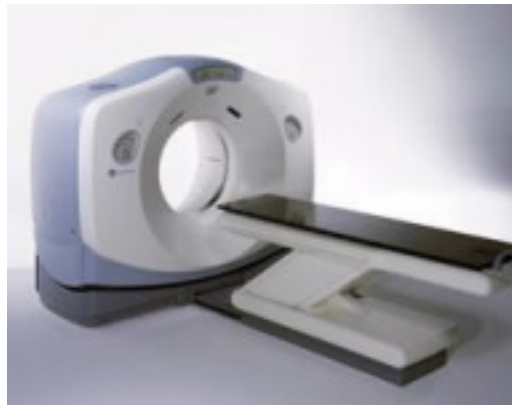


cRespiration

Free breathing

 C-RAD

Entegrasyon



C-RAD

MDAnderson
Cancer Network™

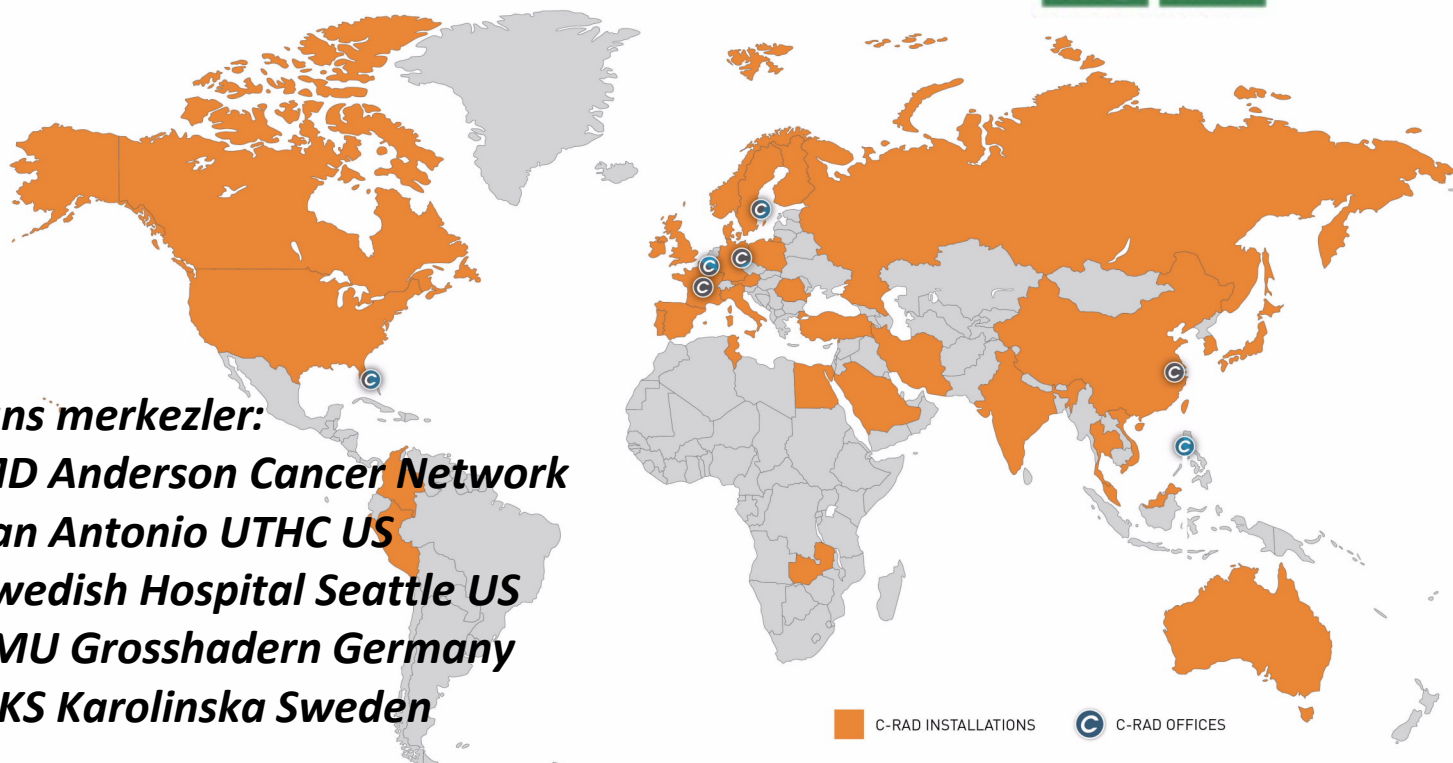
WE MAKE LIVES BETTER
UT HEALTH SCIENCE CENTER®
SAN ANTONIO

SWEDISH

LMU
LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN

KAROLINSKA
UNIVERSITETSSjukhuset

- **Referans merkezler:**
 - **MD Anderson Cancer Network**
 - **San Antonio UTHC US**
 - **Swedish Hospital Seattle US**
 - **LMU Grosshadern Germany**
 - **NKS Karolinska Sweden**



- **Uppsala University Hospital**

Deep inspiration breath-hold gating with surface-imaging and virtual coaching in a reproducible treatment technique for patients with advanced lung cancer

Anna Simonova, Anika Ishida, Florian Tröbes, Ingrid Bode-Wegmann, Stefan Hofmann, Sarah Klein-Schönheit, Claudia Schmidt

Background

- Stereotactic body radiotherapy (SBRT) for early-stage lung cancer requires high precision in target localization and dose delivery.
- The effects of respiratory motion on the treatment course may result in underdosing or overdosing of the target and organs at risk.
- Accurate respiratory motion monitoring is essential for SBRT.

Results

- The range of respiratory motion was measured by 4D CT and 4D PET.
- The accuracy of the respiratory motion monitoring system was evaluated by comparing the results with the gold standard (4D CT).
- There was a correlation between the respiratory motion monitoring system and the gold standard.

Conclusion

- SBRT gating system and reproducible technique for lung cancer treatment.
- The deformable female phantom target volume as well as the dose to the margins are the

Validating the Use of Surface Mapping Tools for Motion and Irregular Breathing Pattern Monitoring on Lung SBRT Patients

Xin Xie, Daling Cai, Virek Mitta, David M. Shepard
Swedish Cancer Institute, Seattle, WA

Application of Surface Mapping in Detecting Swallowing for Head & Neck Cancer

Daling Cai, Xin Xie, Virek Mitta, David M. Shepard
Swedish Cancer Institute, Seattle, WA

Abstract

Background

- The range of respiratory motion was measured by 4D CT and 4D PET.
- The accuracy of the respiratory motion monitoring system was evaluated by comparing the results with the gold standard (4D CT).
- There was a correlation between the respiratory motion monitoring system and the gold standard.

Results

- The range of respiratory motion was measured by 4D CT and 4D PET.
- The accuracy of the respiratory motion monitoring system was evaluated by comparing the results with the gold standard (4D CT).
- There was a correlation between the respiratory motion monitoring system and the gold standard.

Conclusion

- SBRT gating system and reproducible technique for lung cancer treatment.
- The deformable female phantom target volume as well as the dose to the margins are the

Sliced Mary: a deformable phantom for the validation of set-up based on surface imaging in radiotherapy treatments

S. Pallotta^{1,2}, S. Rana², M. Esposito², L. Moriconi², C. Talamanti^{1,2}, P. Bonetti², F. Pini², L. Livi², C. Veronesi²

Abstract

Background

- The range of respiratory motion was measured by 4D CT and 4D PET.
- The accuracy of the respiratory motion monitoring system was evaluated by comparing the results with the gold standard (4D CT).
- There was a correlation between the respiratory motion monitoring system and the gold standard.

Results

- The range of respiratory motion was measured by 4D CT and 4D PET.
- The accuracy of the respiratory motion monitoring system was evaluated by comparing the results with the gold standard (4D CT).
- There was a correlation between the respiratory motion monitoring system and the gold standard.

Conclusion

- SBRT gating system and reproducible technique for lung cancer treatment.
- The deformable female phantom target volume as well as the dose to the margins are the

Testing the C-RAD Catalyst elastic image registration software using a deformable female phantom

OBJECTIVES: "IMMERSA PHANTOM, RADIO THERAPY, LUNG, BREAST, GYN, ORTHO, DERMAT, PEDIAT, HEAD & NECK, PROSTATE, PANCREAS, LIVER, LUNG, BLADDER"

University of Florence/Department of Oncological and Radiotherapy Sciences, Florence, Italy; "C-RAD Catalyst"

University of Florence/Department of Oncological and Radiotherapy Sciences, Florence, Italy; "C-RAD Catalyst"

Abstract

Background

- The range of respiratory motion was measured by 4D CT and 4D PET.
- The accuracy of the respiratory motion monitoring system was evaluated by comparing the results with the gold standard (4D CT).
- There was a correlation between the respiratory motion monitoring system and the gold standard.

Results

- The range of respiratory motion was measured by 4D CT and 4D PET.
- The accuracy of the respiratory motion monitoring system was evaluated by comparing the results with the gold standard (4D CT).
- There was a correlation between the respiratory motion monitoring system and the gold standard.

Conclusion

- SBRT gating system and reproducible technique for lung cancer treatment.
- The deformable female phantom target volume as well as the dose to the margins are the

Is surface based setup preferable to conventional setup for breast cancer patients?

IS. Elshorbagy, C. Thirumangalakudi, A. Elshorbagy, S. Elshorbagy
"Glasgow University Hospital, Department of Oncology and Radiation Physics, Lead, Scotland"
"Leeds University, Department of Medical Radiation Physics, Lead, Scotland"
"Glasgow University Hospital, Department of Oncology and Radiation Physics, Lead, Scotland"

Objectives:

To compare the accuracy of surface based setup (SBS) with conventional setup (CS) for breast cancer patients.

Methods:

Two patient groups were included in the study to enable a comparison between SBS and CS. The breast position for the two groups was verified with a field image (FI). Clinical tolerance was a shift of 4 mm in the left-right (L-R), anterior-posterior (A-P) and superior-inferior (S-I) directions, respectively. At the treatment machine, all patients were initially positioned in supine position on a breast board (ProBoard™-2 Breastboard, CIVCO Medical Solutions) with their arms raised over the head.

Results:

Twenty patients were enrolled in the first group. The patients were positioned with room laser and verification images were acquired according to the NAL-protocol. The first three treatment sessions were excluded in the results of this study.

Conclusions:

The second group (twenty-five patients) was positioned with SBS. Structure set and isocenter was imported from the TPS (Eclipse version 10.6.28, Varian medical systems, CA, Varian), through import of the industry standard DICOM format.

Klinik Çalışmalar

- **Evaluation of the Spatial Reproducibility and Temporal Drift of the CRAD Catalyst HD System, UT, San Antonio, USA**
- **A novel surface imaging system for patient positioning and surveillance during radiotherapy, UMM, Germany**
- **Quantification of the correlation between surface tracking signal and internal body structure position during deep inspiration breath hold (DIBH) based on single-acquisition CBCT, UMM, Germany**
- **Optical surface scanning for respiratory motion monitoring in radiotherapy: a feasibility study, Herlev Hospital, University of Copenhagen, Denmark**
- **Reduced fixation with optical monitoring for palliative whole brain radiotherapy treatment, SUS, Sweden**
- **Testing the C-RAD Catalyst elastic image registration software using a deformable female phantom, University of Florence-Department, Careggi-Radiotherapy, Florence, Italy**
- **Is surface based setup preferable to conventional setup for breast cancer patients? SUS, Sweden**
- **Sliced Mary: a deformable phantom for the validation of set-up based on surface imaging in radiotherapy treatments, Careggi-Radiotherapy, Florence, Italy**
- **Sentinel/Catalyst surface tracking system for respiratory gating. Skåne University Hospital, SUS, Sweden**

Sonuç



@catalyst

SENTINEL



- Gerçek zamanlı yüzeyel IGRT
- Doz yok, marker yok, invaziv değil
- Hasta pozisyonlamada renkli projeksiyon sistemi
- Rijit-olmayan algoritma
- Sesli ve görsel uyarı, hasta eğitimi kolay
- Personel için kullanımı kolay
- Bütün LINAK cihazlarıyla entegre olabilir

İletişim

Yiğit Çeçen

Medikal Fizik Müdürü

yigit.cecen@oncotech.com.tr

Tel: 0312 394 07 08



Teşekkürler

Geleceğin minik mimarları
çocuklarımızın ve çocuk kadar
temiz kalanların
23 Nisan Ulusal Egemenlik
ve
Çocuk Bayramını Kutlarım...