Dual Energy CT for Radiation Therapy: Technical Considerations and Clinical Applications
Clinical Applications

Courtesy of MAASTRO Clinic, The Netherlands
What makes Dual Energy stand out?

**Improved tumor visualization**
Increased confidence in tumor contouring with the use of monoenergetic energies acquired with Dual Energy technologies tailored to each scanner.

**Artifact reduction**
Increased process efficiency and potentially improved clinical outcomes using Dual Energy for metal artifact reduction.

**Tissue characterization**
Increase the competitiveness of your institution – use Rho and Z as the new foundation for dosimetric calculations and tissue differentiation to put yourself at the forefront of innovation.
Metal artefact reduction

Conventional CT

Dual Energy CT

Pelvis images courtesy of Radiologische Allianz Hamburg
Spine images courtesy of Clinique CIMOP Bizet / Paris, France
Dual Energy Monoenergy +
Different keV lead to different image impressions
syngo.CT DE Monoenergetic Plus\(^1\) – Enhances soft tissue contrast

**syngo.CT DE Monoenergetic Plus\(^2\)**

“Monoenergetic reconstructions at **60 keV** of DECT imaging of head and neck SCC result in a significantly improved overall image quality\(^1\)”

![60keV (Dual Energy) vs. 120 kV comparison](image-url)
Dual Energy Monoenergy + Brain metastases

120 kV

T1 WI MRI with Contrast

Courtesy of Fox Chase Cancer Center, Philadelphia PA
Electron Density and Effective Atomic Number – Proton Therapy

- Access to electron density and effective atomic number maps in one examination
- Interactive adjustment of material decomposition parameters for immediate optimization of the results
- Separate windowing of low and high kV datasets
What is Iodine Map?
Liver VNC /Lung PBV/ Brain Hemorrhage /Virtual Unenhanced

HU (Low kV)

Fat

Soft Tissue

Iodine

HU (High kV)
True and Virtual Non-contrast Images (VNC)

True Non Contrast

Virtual Non Contrast

Courtesy of Ludwig-Maximilians-Universität, Klinikum Großhadern, Munich, Germany
Lung perfused blood volume - Potentially Sparing Lung IMRT and SBRT planning

“DECT iodine maps strongly correlate with standard SPECT/CT for evaluation of differential lung function”

“The use of functional imaging reveals significant variation in functional dosimetric parameters as compared to standard anatomical dosimetry in SABR and IMRT plans”

Courtesy of Centre Hospitalier de l’Université de Montréal; 1) Houda et al, Phase I-II Study of Dual Energy Computed Tomography (DECT) for Assessment of Pulmonary Function in Radiotherapy Planning, Journal of Radiation Oncology. vol 120, p17, (Sep 2017)
Technical considerations
Dual Energy CT – Various approaches

- Dual Source
- TwinBeam
- Dual Spiral

- Fast kV Switching
- Dual Layer
- Slow kV switching
Dual Spiral Dual Energy

1\textsuperscript{st} spiral @ low kV

2\textsuperscript{nd} spiral @ high kV

- Full number of projections
- Full routine ready
- All dose reduction features available
TwinBeam Dual Energy

Moveable split filter:
- Gold (Au, 0.05 mm)
- Tin (Sn, 0.6 mm)

Simultaneous acquisition of low and high energy spectra

X-ray tube
Detector

Split filter

Au
Sn
DSCT System Design

- Two X-ray tubes at 95° each with 100 or 120 kW
- Two detectors at 95° each with 0.6mm collimation and double z-sampling (z-flying focal spot)
- 0.25s/0.28 s gantry rotation time\(^1\)

1. Actual gantry rotation time depends on dual source scanner model
Dual Energy CT – Various approaches

**Dual Source**
- Simultaneous acquisition
- Best energy separation
- Limited DE field of view

**TwinBeam**
- “Simultaneous” acquisition
- Decent energy separation
- 50 cm DE field of view

**Dual Spiral**
- Sequential acquisition
- Good energy separation
- 50 cm DE field of view
The animation of the dot pulse can be optionally switched off on the master layout. Go to View > Slide Master. After that go to Animations > Animations Pane.