Ask EuroSafe Imaging
Tips & Tricks

CT Working Group

Composed Images using Dual Energy CT

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Background

- Image contrast and image noise increase with lower photon energies.
- Image contrast and image noise decrease with higher photon energies.
- The relation is non-linear.
- Dual Energy examinations produce two different data sets of the same volume, one at low energy and one at high energy.
- Higher mean differences between the low and the high photon energies allow for better spectral separation.
Energy dependent attenuation

Highest contrast between iodine and body tissues (water/fat) can be obtained at photon energy levels approaching the k-edge of iodine.

\[ k\text{-edge}_{\text{iodine}} \]
Dual Energy techniques

Different vendors offer different technical solutions:\n
Main differences are:
- spectral separation (currently highest values with Dual Source CT)
- temporal offset (currently lowest values with Sandwich Detector CT)
Composed images

- Frequency selective filtering of image information and subsequent non-linear composition is advantageous:
  - High image contrast from the low energy data
  - Low image noise from the high energy data
- Weighting factors are indexing the relation of image information contributing to the composed image
  - e.g. 0.7 represents 70% image information from the low spectra and 30% of the high spectra
- Increased Contrast-to-Noise-Ratio (CNR), especially if referenced to radiation dose (CNRD).
- Increased soft tissue contrast and lesion delineation in contrast enhanced examinations$^2$.
- Can be used to reduce radiation exposure and iodine dosage$^3$. 
Composed images

Low spectra

High spectra

Composed image
Image quality

CNRD results for thoracoabdominal CT from the University Hospital Erlangen (2015):

- Fixed 120kV
- Automated Tube Voltage Adaptation
- Dual Source Dual Energy
- Split Filter Dual Energy
Cases: Abdomen

120kV

Dual Energy composed image (weighting factor = 0.7)

W/C = 400/40
Cases: Head and Neck

70kV

Dual Energy composed image (weighting factor = 0.7)

W/C = 400/40
References


