

Ask EuroSafe Imaging Tips & Tricks

CT Working Group

Composed Images using Dual Energy CT

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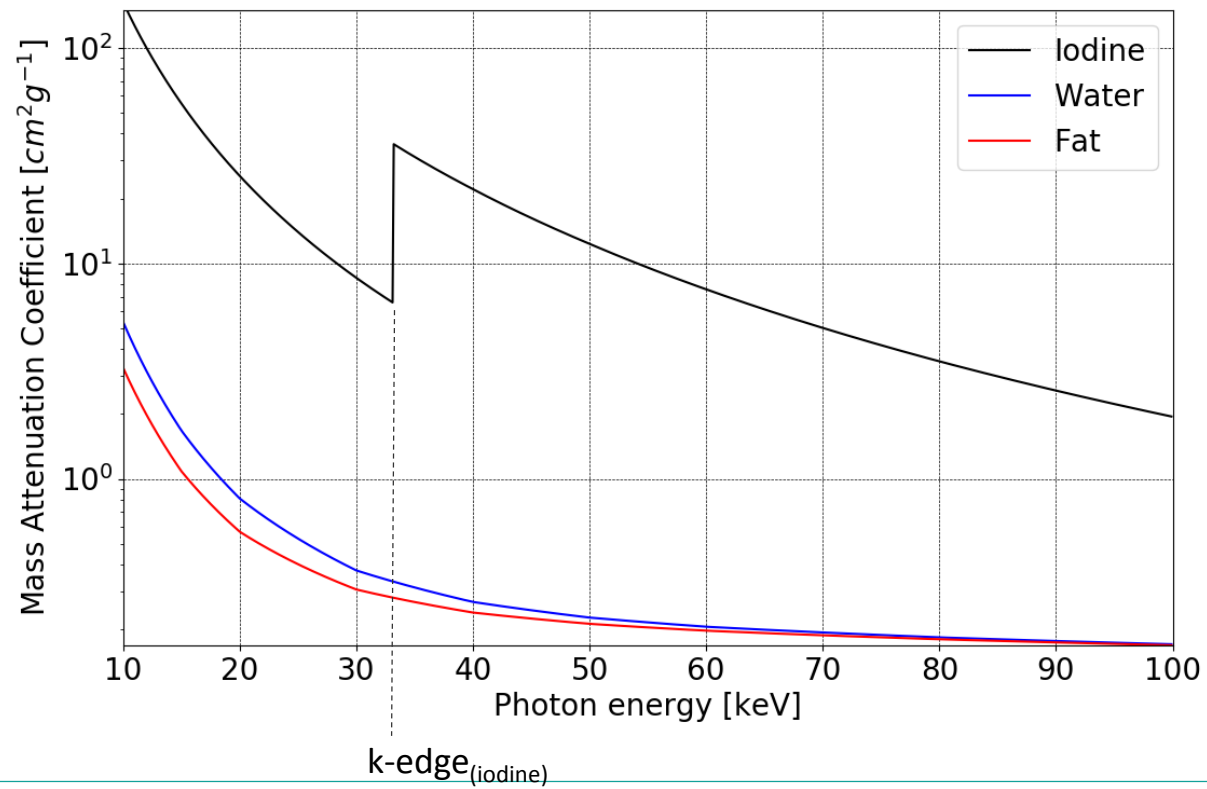
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Background

- 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.

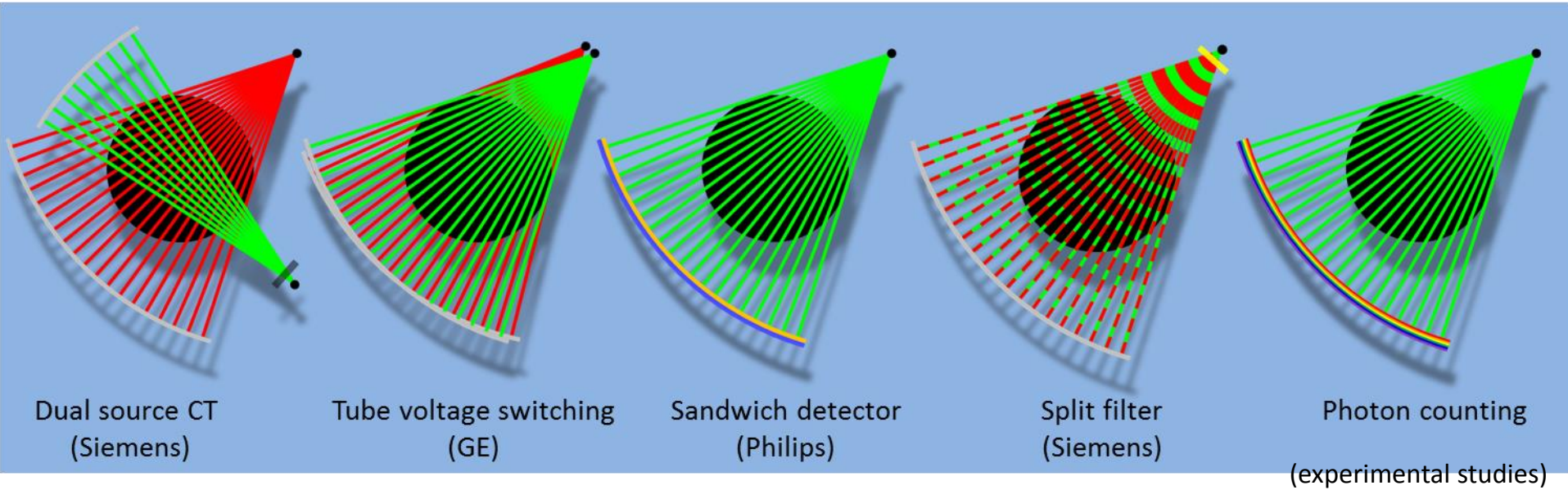
Energy dependent attenuation

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



Dual Energy techniques

Different vendors offer different technical solutions¹:



Main differences are:

- spectral separation (currently highest values with Dual Source CT)
- temporal offset (currently lowest values with Sandwich Detector CT)

Composed images

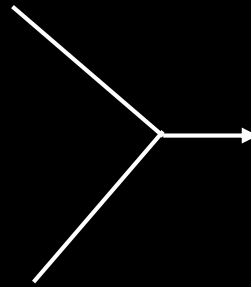
- Frequency selective filtering of image information and subsequent non-linear composition is advantageous:
 - High image contrast from the low energy data
 - Low image noise from the high energy data
- Weighting factors are indexing the relation of image information contributing to the composed image
 - 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 examinations².
- Can be used to reduce radiation exposure and iodine dosage³.

Composed images

Low spectra



High spectra

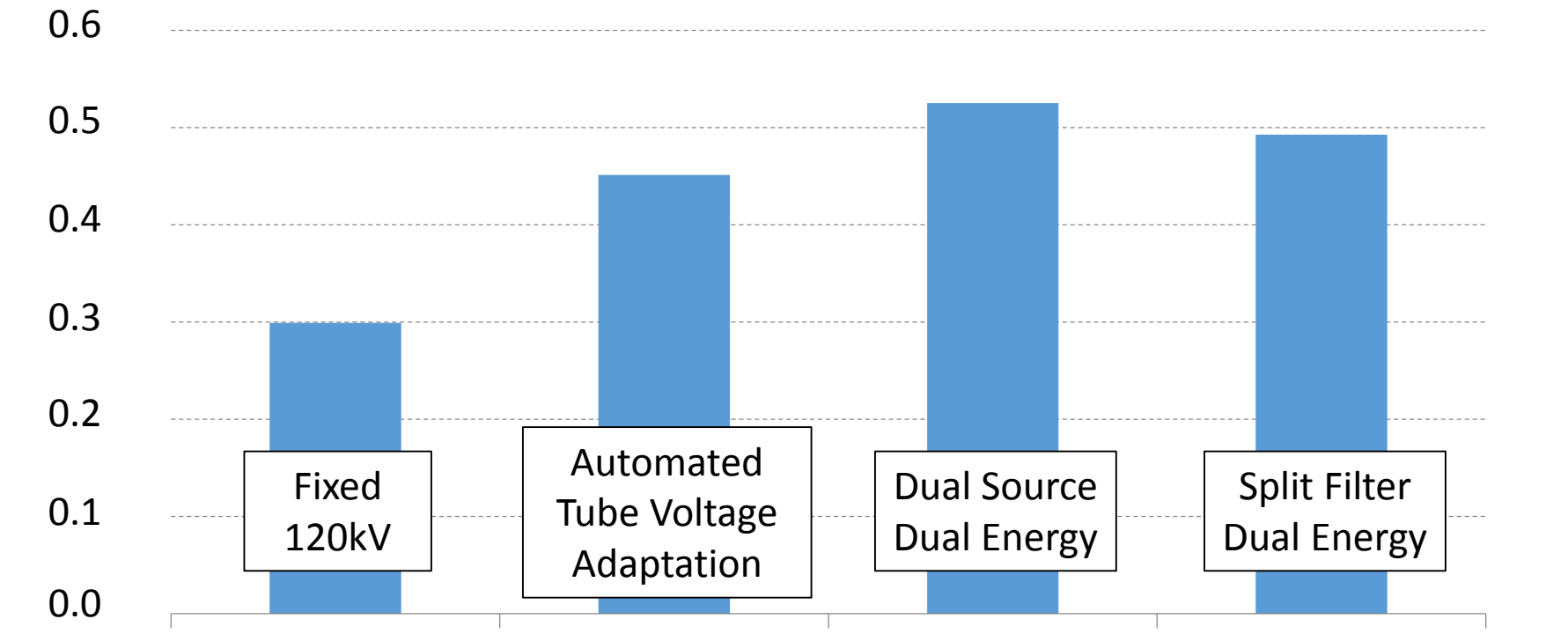


Composed image



Image quality

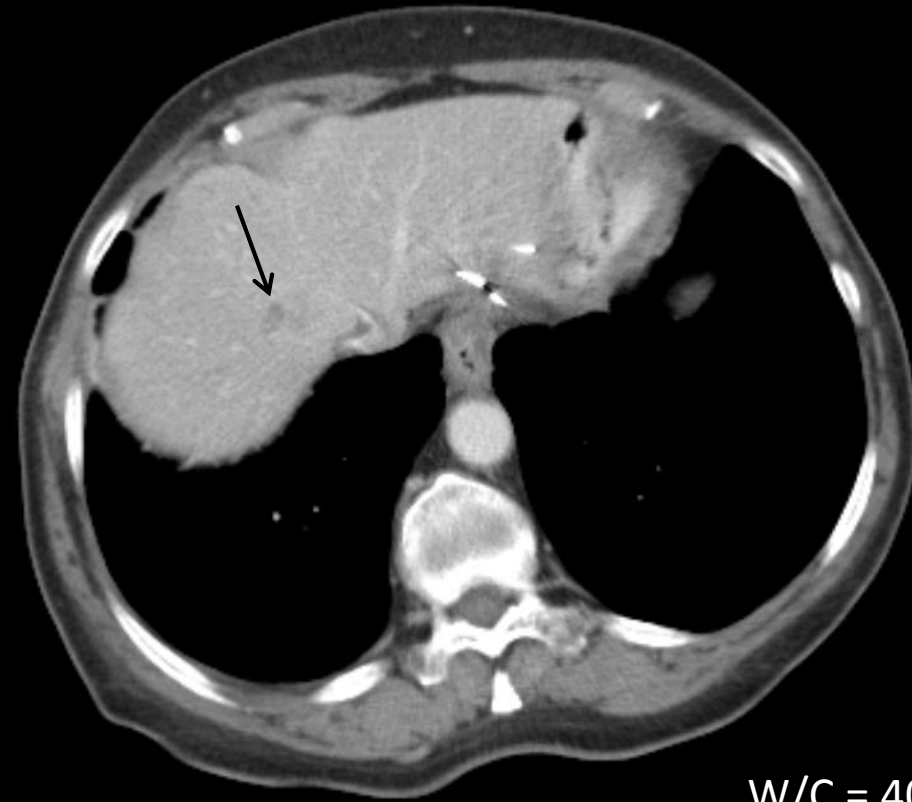
CNRD results for thoracoabdominal CT from the University Hospital Erlangen (2015):



Cases: Abdomen

120kV

Dual Energy composed image
(weighting factor = 0.7)



W/C = 400/40

Cases: Head and Neck⁴

70kV



Dual Energy composed image
(weighting factor = 0.7)



W/C = 400/40

References

1. Faby S, Kuchenbecker S, Sawall S, et al. Performance of today's dual energy CT and future multi energy CT in virtual non-contrast imaging and in iodine quantification: A simulation study. *Med Phys*. 2015 Jul;42(7):4349-66.
2. Quiney B, Harris A, McLaughlin P, et al. Dual-energy CT increases reader confidence in the detection and diagnosis of hypoattenuating pancreatic lesions. *Abdom Imaging*. 2015 Apr;40(4):859-64.
3. Schmidt D, Söderberg M, Nilsson M, et al. Evaluation of image quality and radiation dose of abdominal dual-energy CT. *Acta Radiol*. 2017 Jan 1:284185117732806.
4. May MS, Bruegel J, Brand M, et al. Computed Tomography of the Head and Neck Region for Tumor Staging-Comparison of Dual-Source, Dual-Energy and Low-Kilovolt, Single-Energy Acquisitions. *Invest Radiol*. 2017 Sep;52(9):522-528.