

Clinical Dual Energy CT (DECT): Can Monoenergetic Imaging Remove Metal Artifacts?

Stefan Kuchenbecker¹, Sebastian Faby¹, Sören Schüller¹,
Michael Lell², and Marc Kachelrieß^{1,3}

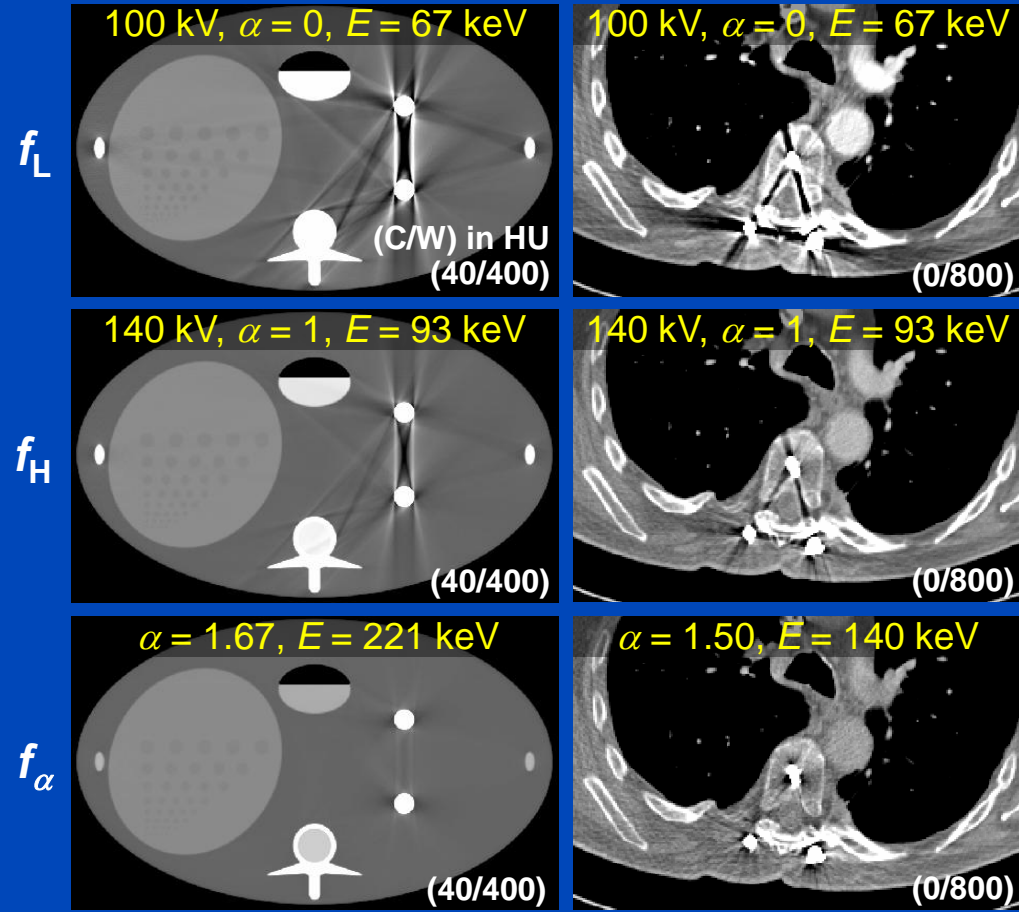
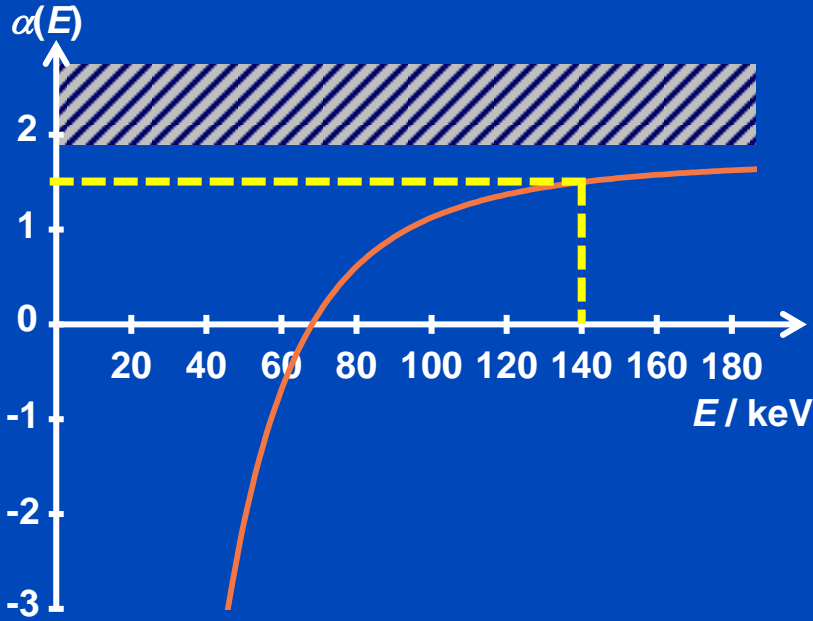
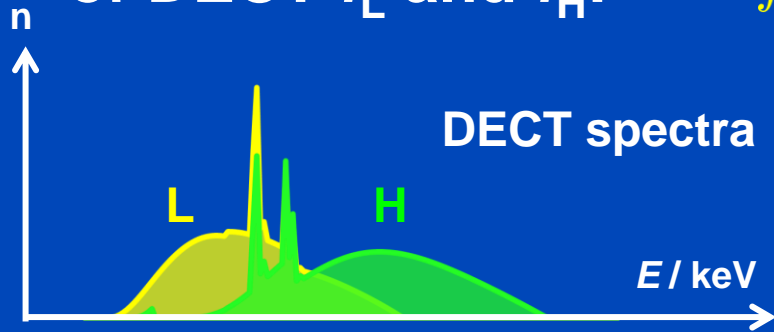
¹German Cancer Research Center (DKFZ), Heidelberg, Germany

²University Clinics Erlangen, Germany

³Friedrich-Alexander-University (FAU) Erlangen-Nürnberg, Germany

DECT and Pseudo Monochromatic Imaging

Pseudo monochromatic imaging is a linear combination of DECT f_L and f_H : $f_\alpha = (1 - \alpha) f_L + \alpha f_H$



Monochromatic Imaging

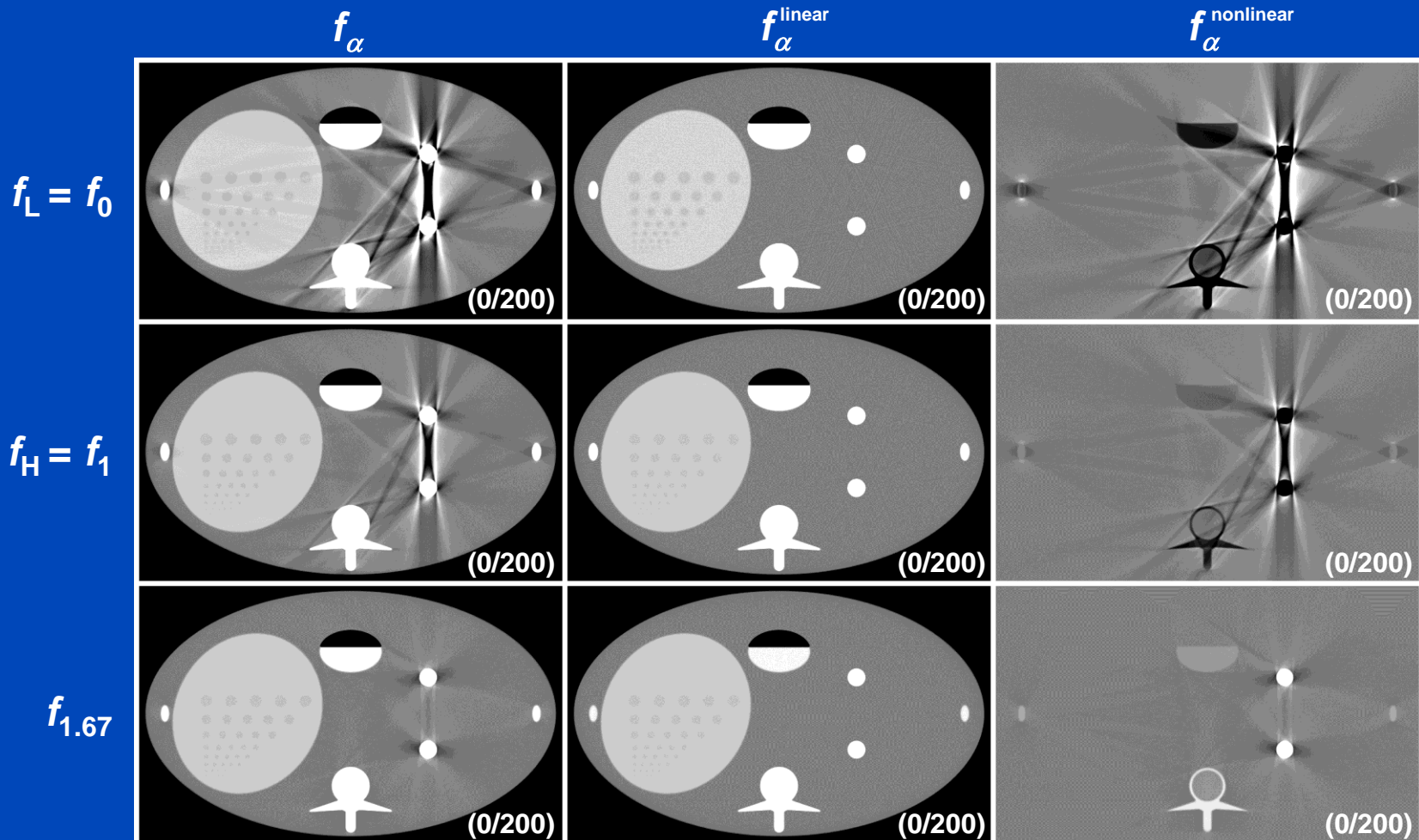
- **Pseudo monochromatic imaging** $f_\alpha = (1 - \alpha) f_L + \alpha f_H$
 - Image-based postprocessing
 - Provided in clinical DECT scanners
- **Virtual monochromatic imaging** $g_\alpha = (1 - \alpha) g_L + \alpha g_H$
 - Rawdata-based preprocessing
 - Constraint on consistent rawdata
- **True monochromatic imaging**
 - Would require monochromatic x-rays – not applicable here

$$q_L = -\ln \int dE w_L(E) e^{-p_W \mu_W(E) - p_B \mu_B(E)}$$
$$q_H = -\ln \int dE w_H(E) e^{-p_W \mu_W(E) - p_B \mu_B(E)}$$

Series Expansion

- Series expansion of the polychromatic attenuation:

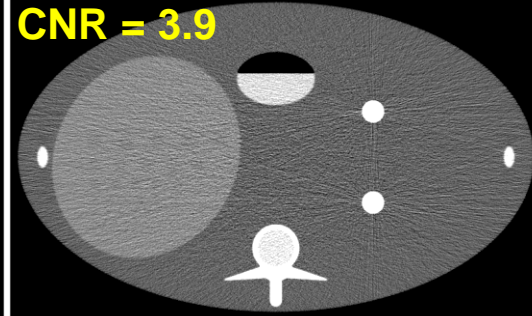
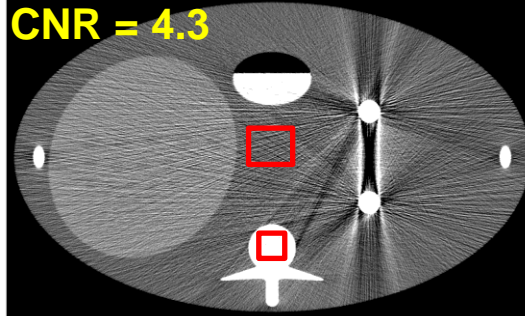
$$q_j = -\ln \int dE w_j(E) e^{-p_W \mu_W(E) - p_B \mu_B(E)} = \sum_{kl} c_{jkl} p_W^k p_B^l$$



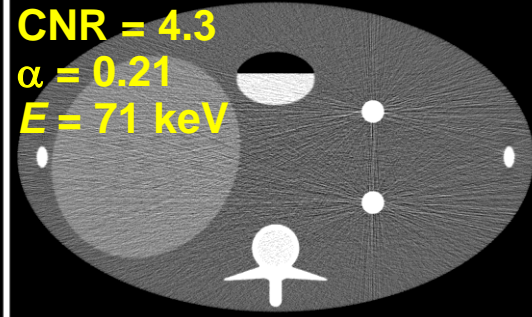
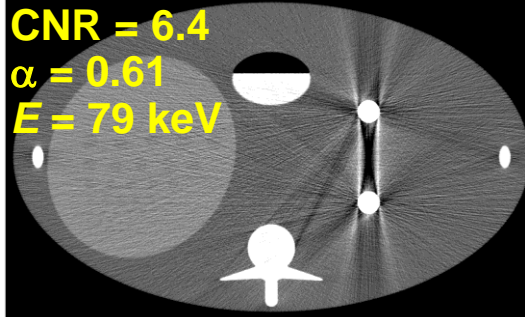
pseudo monochromatic
image-based processing

virtual monochromatic
rawdata-based processing

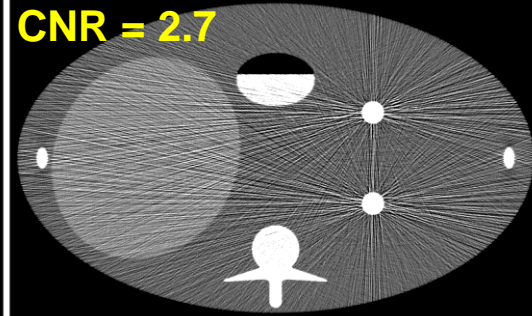
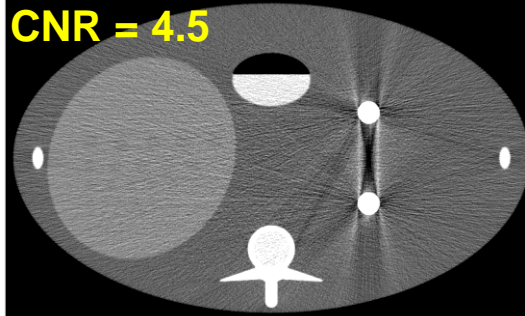
$f_L = f_0$
($E = 67$ keV)



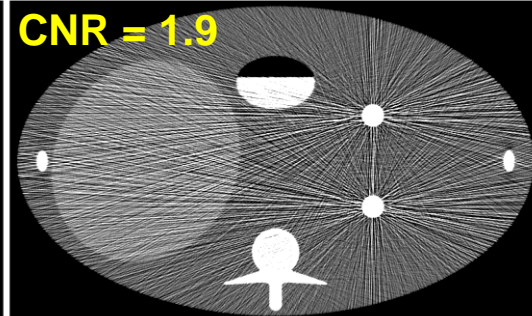
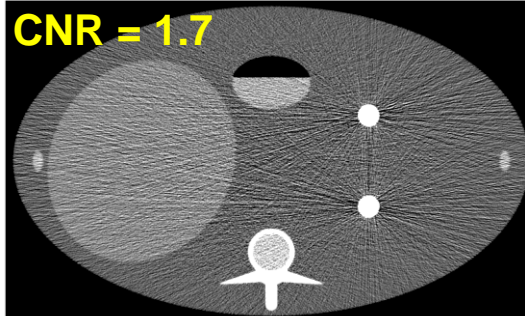
maximum CNR



$f_H = f_1$
($E = 93$ keV)



$f_{1.67}$
($E = 221$ keV)



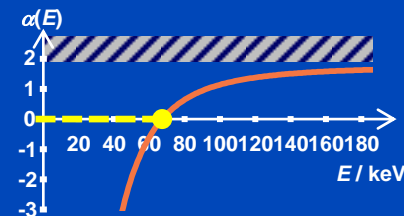
$C = 40$ HU,
 $W = 400$ HU

Patient Data Set – Pseudo Monochromatic Imaging

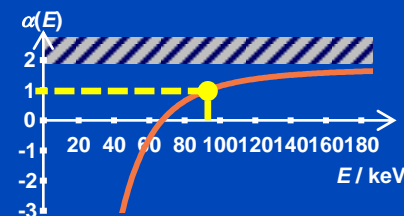
$z = -723$ mm

$z = -792$ mm

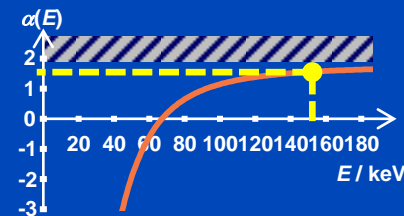
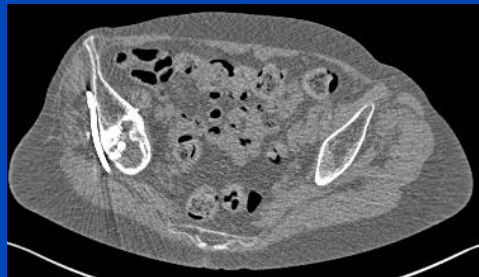
$f_L = f_0$
($E = 67$ keV)



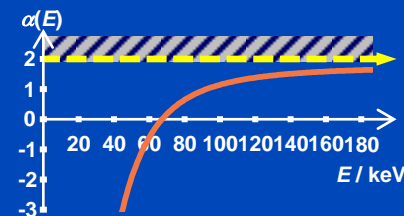
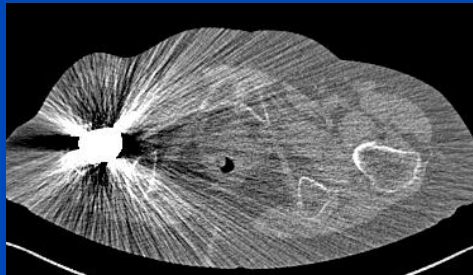
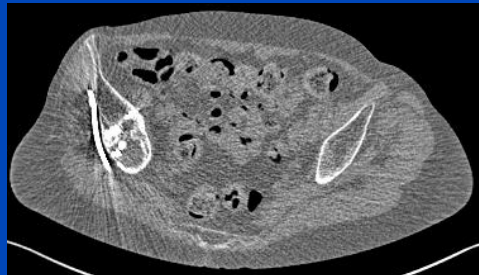
$f_H = f_1$
($E = 93$ keV)



$f_{1.55}$
($E = 154$ keV)



$f_{2.00}$
($E = \text{---}$ keV)



$C = 0$ HU, $W = 800$ HU

Conclusion

- **Pseudo monochromatic imaging**
 - cannot completely remove metal artifacts,
 - can sometimes reduce metal artifacts,
 - reduces CNR if used for metal artifact reduction.
- **Rawdata-based methods should be preferred.**
- **The additional information available in DECT should be used for spectral imaging rather than for artifact reduction.**

Thank You!

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