Microtomography for small-animal bone imaging

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  - Unsharp masking
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- **Conclusion**
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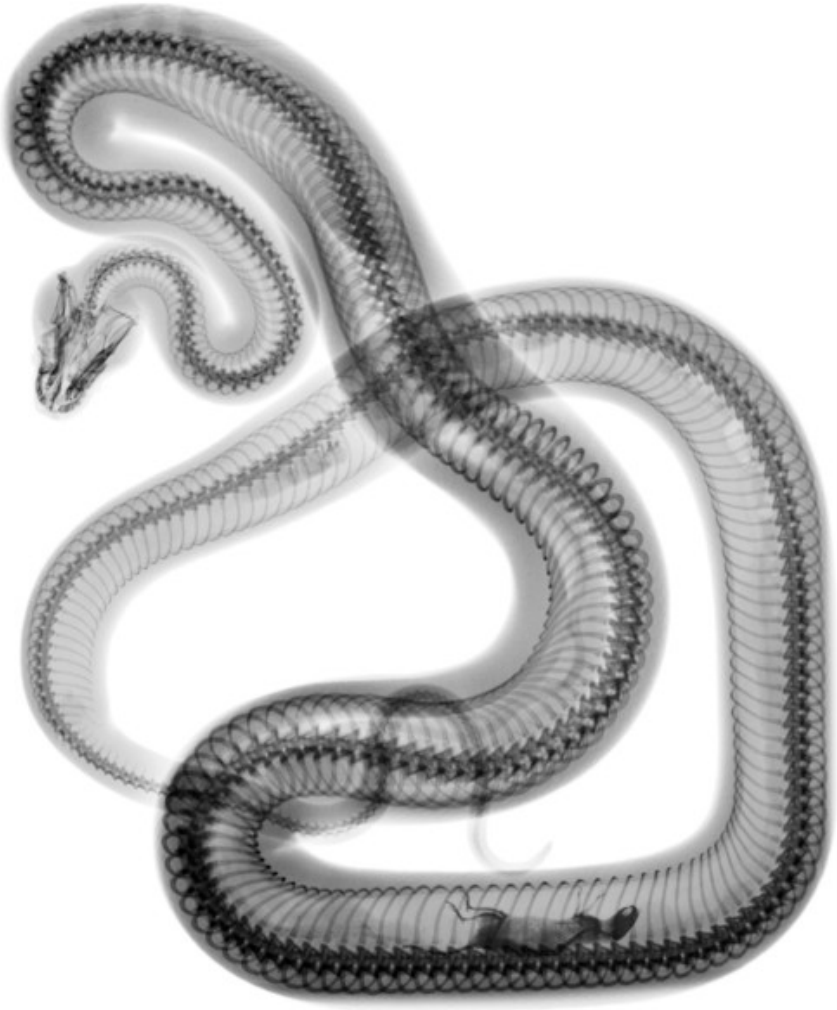
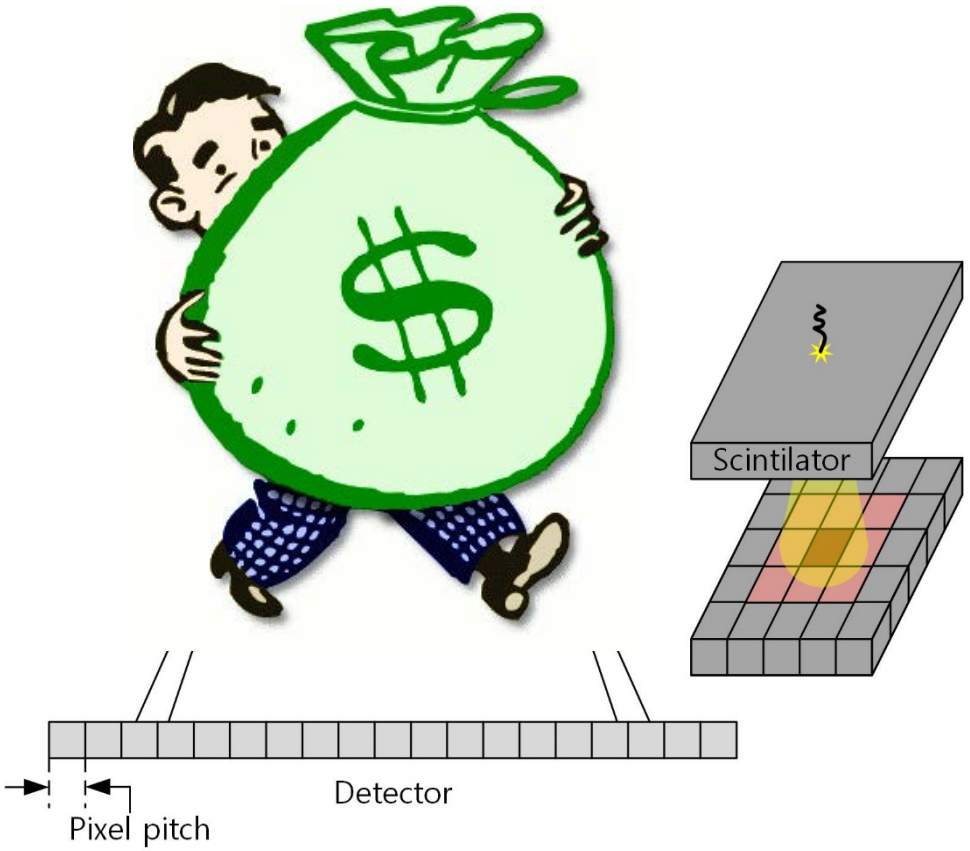
Microtomography





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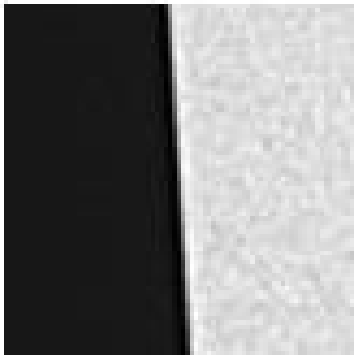
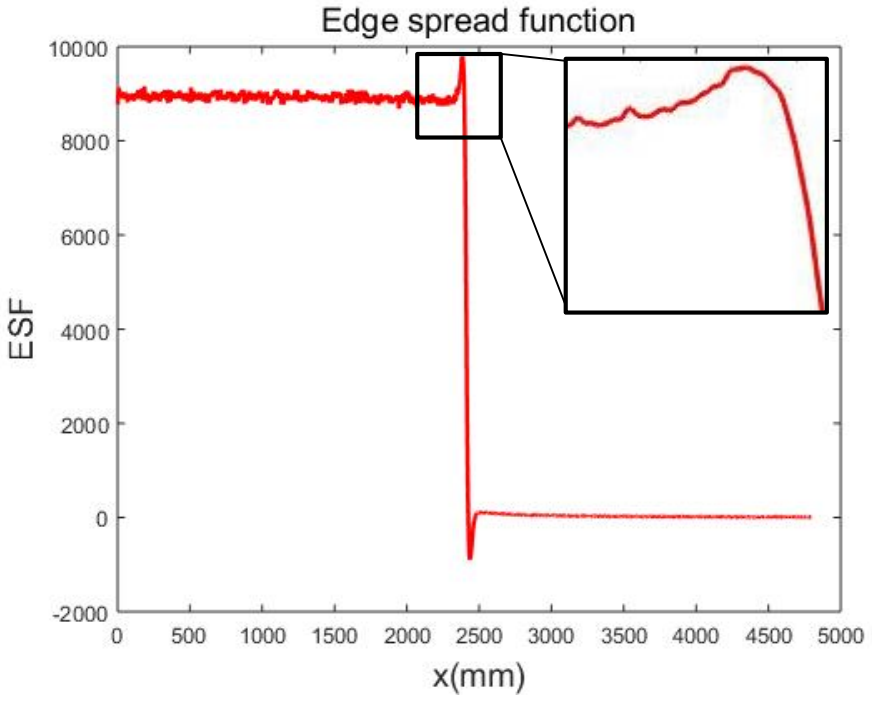
Unsharp masking





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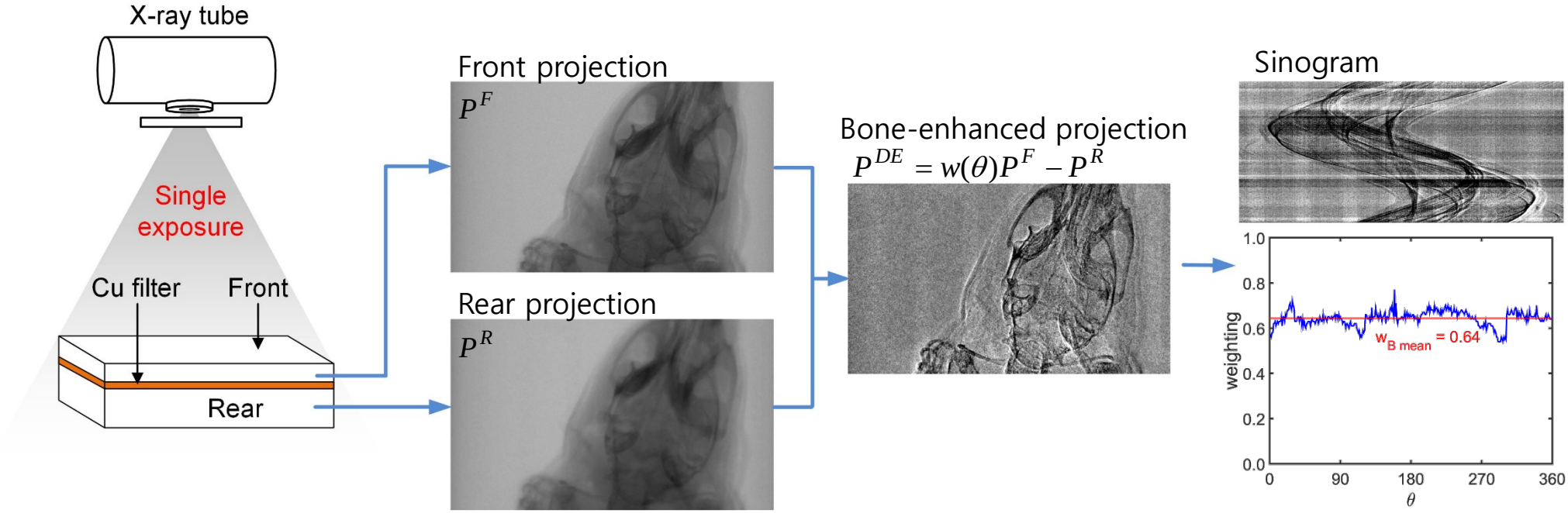
Multilayer detector



- Place a lower-resolution flat-panel detector (FPD) behind the main high-resolution FPD and thus configure a sandwich-style detector.
- Obtain subtraction projections using two images obtained from the front (high-resolution) and rear (low-resolution) FPDs so as to produce bone enhanced projections.
- Reconstruct tomographic images using bone-enhanced sonogram.

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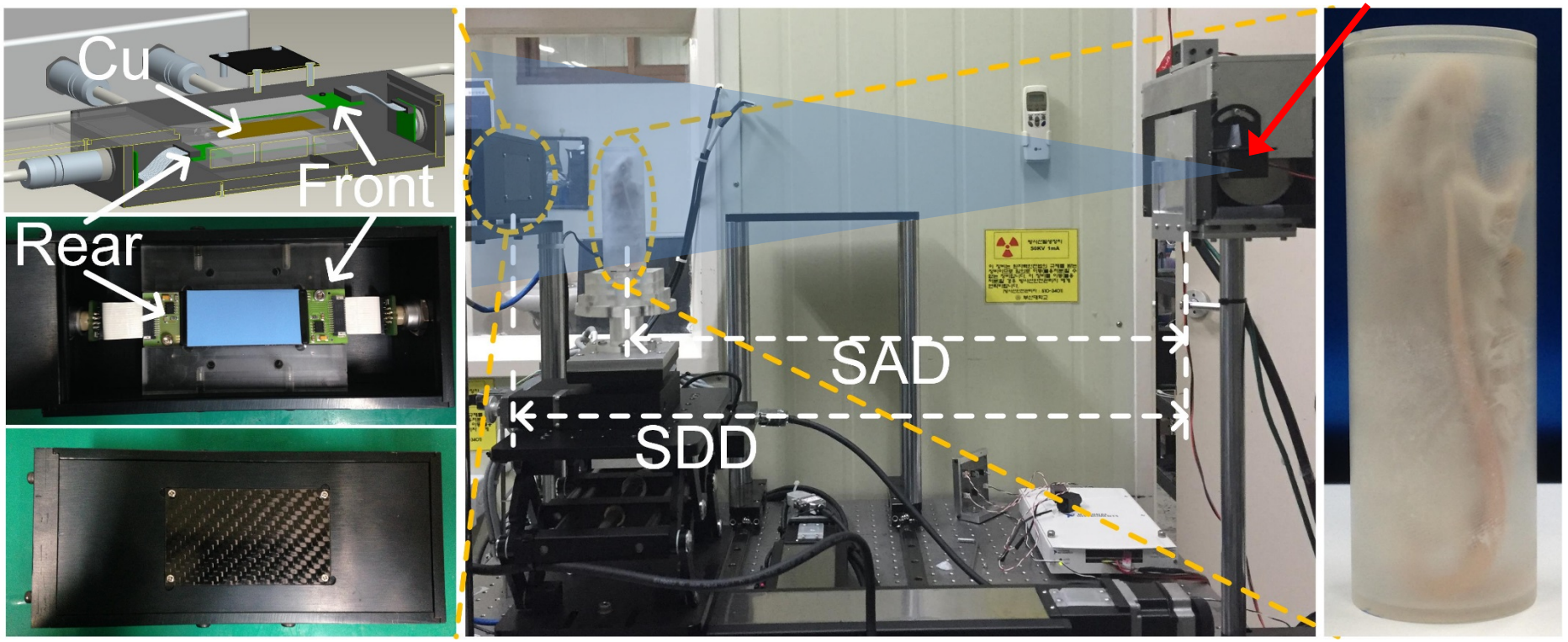
Experimental layout



Detector Specification	Phosphor	W/Al tube voltage/current	Detector integration time	SDD/SAD	Intermediate filter
Gd_2O_2S:Tb phosphor 0.048-mm pixel pitch 512 × 1024 pixels	(F) 34 mg/cm^2 (0.084 mm) (R) 67 mg/cm^2 (0.18 mm)	50 kVp / 0.9 mA	3000 ms	600/550 mm	0.0 mmCu 0.3 mmCu

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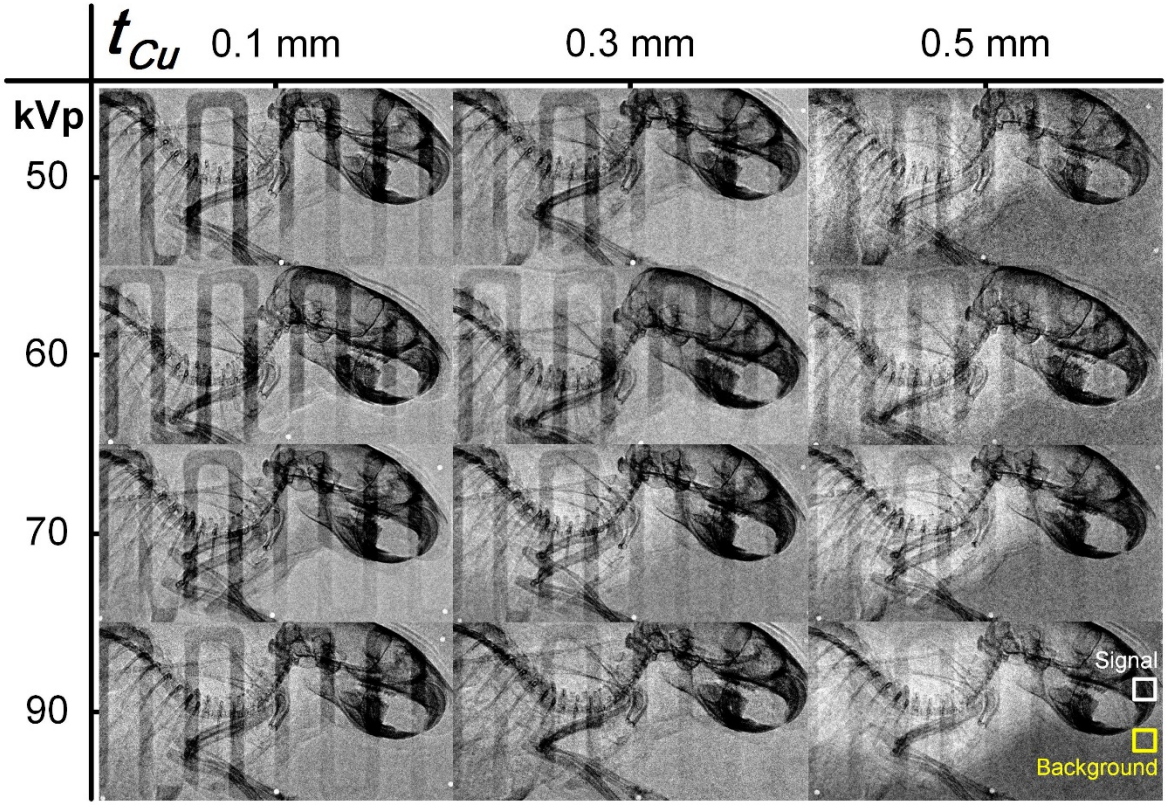
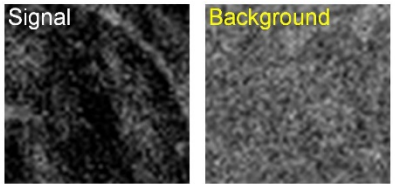
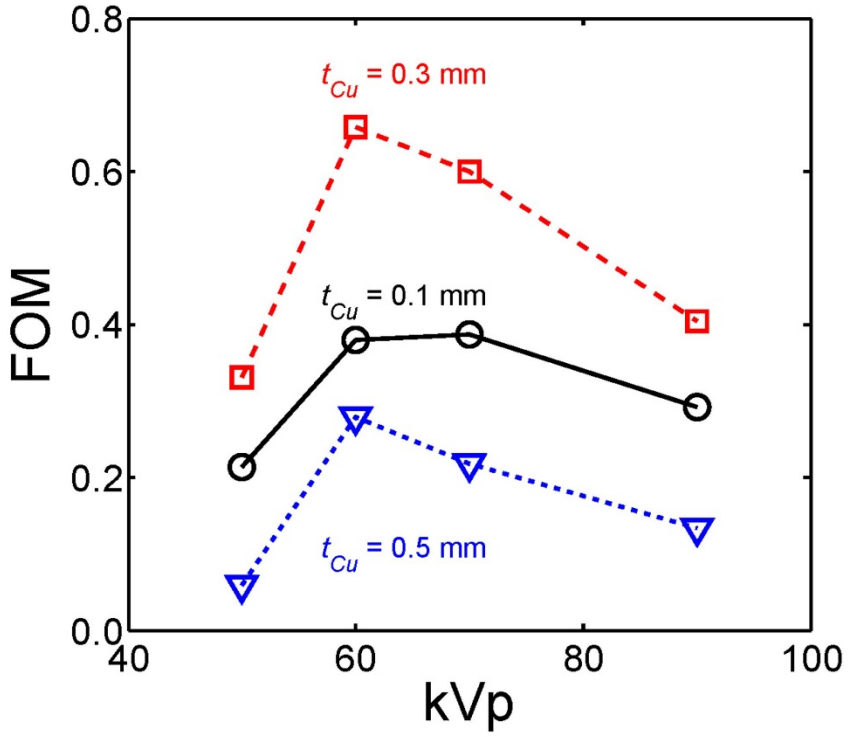
Dual-energy FOM







$$\mathrm{FOM} = \frac{\mathrm{CNR}^2}{X_F} = \frac{\left|\bar{d}_{\mathrm{bone}} - \bar{d}_{\mathrm{bgn}}\right|^2}{X_F\left(\sigma^2_{\mathrm{bone}} + \sigma^2_{\mathrm{bgn}}\right)}$$

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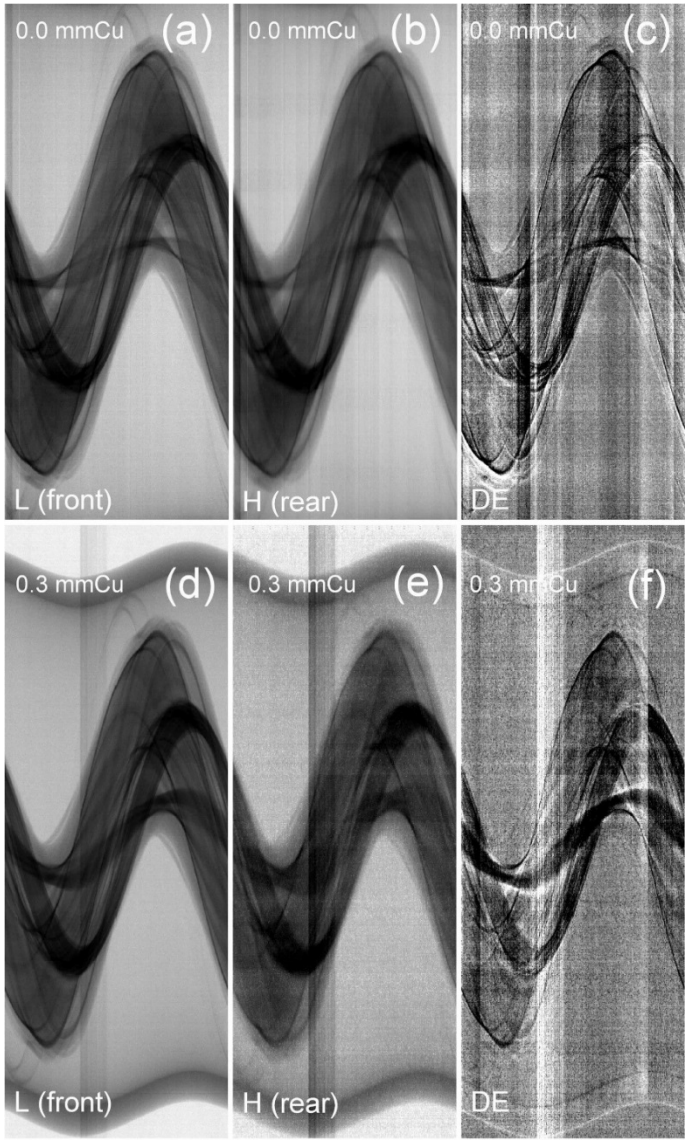
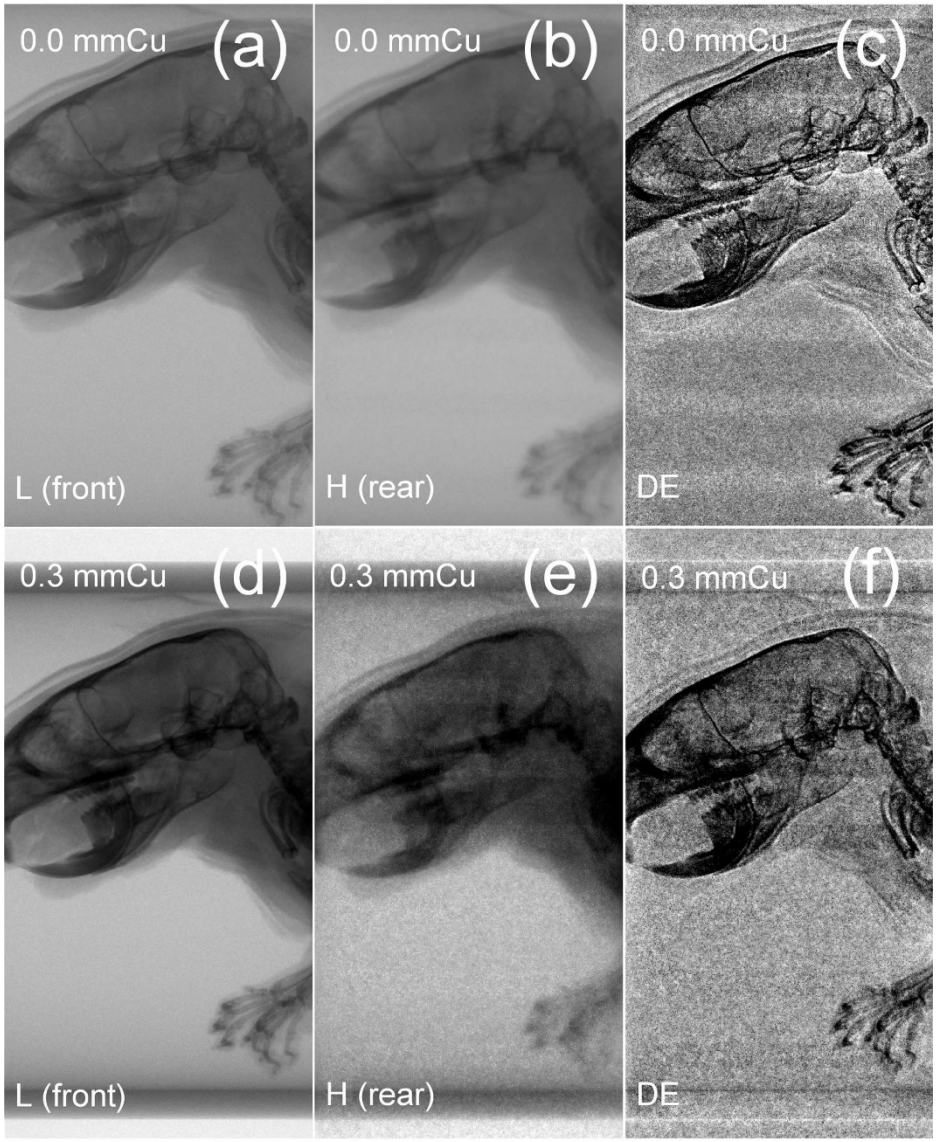
Results





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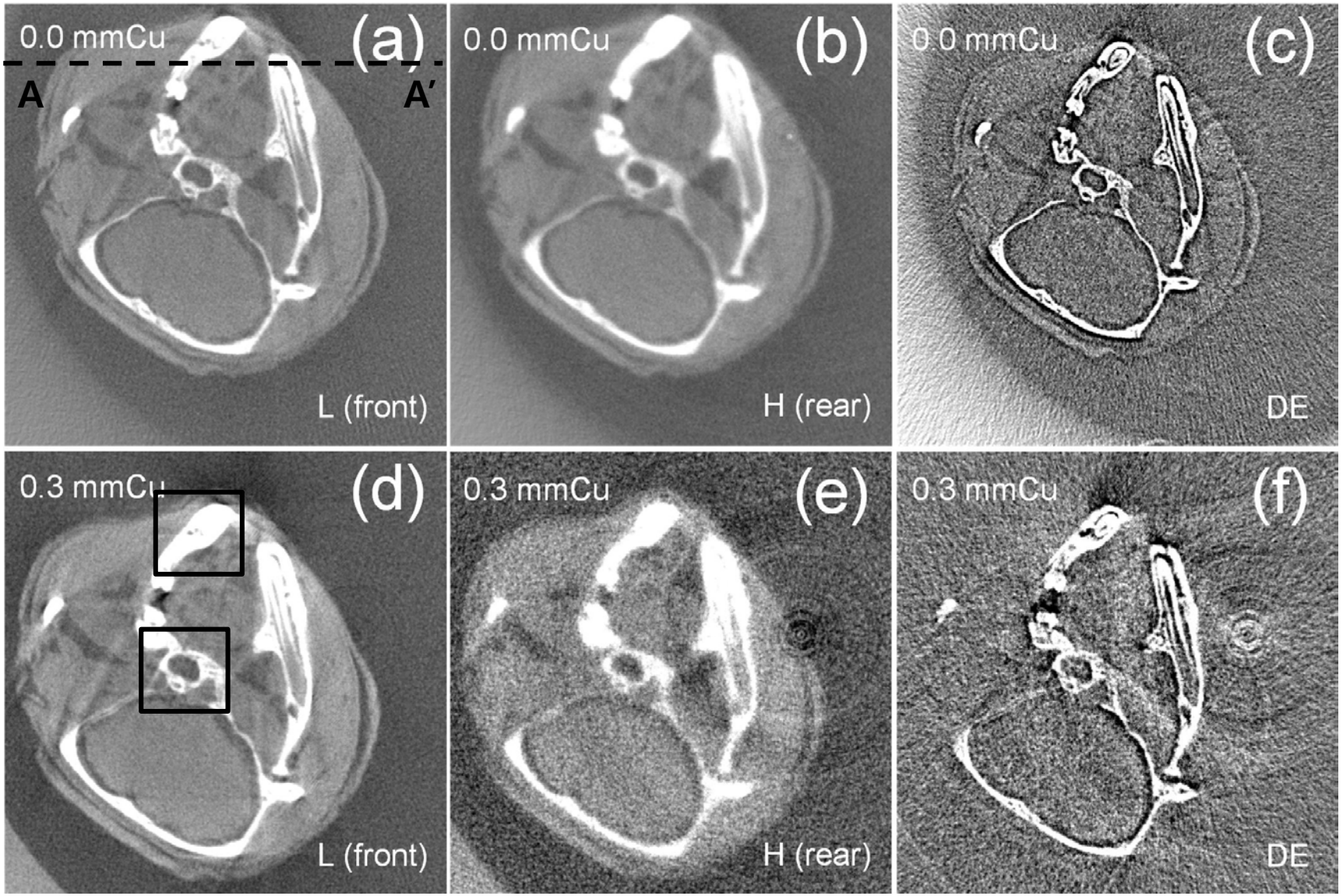

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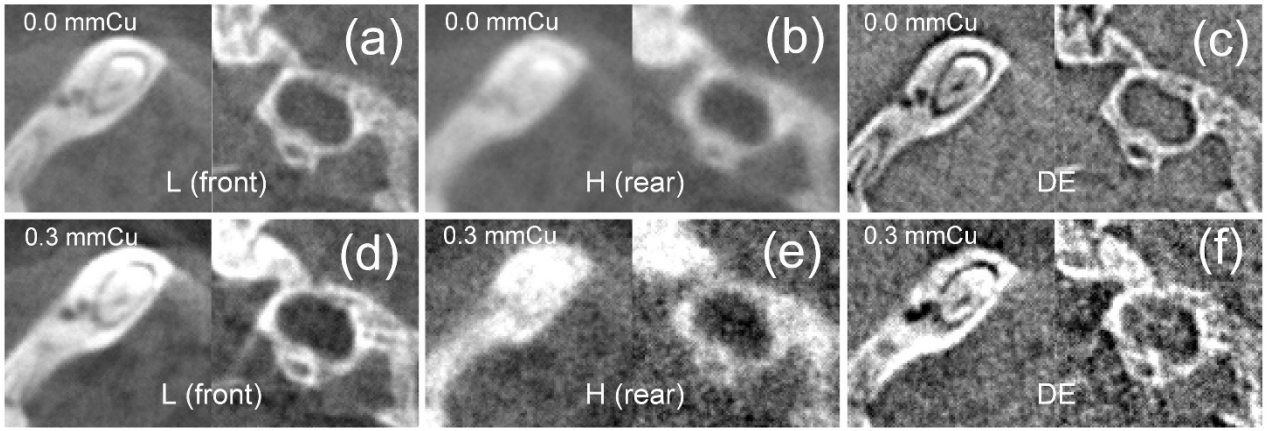

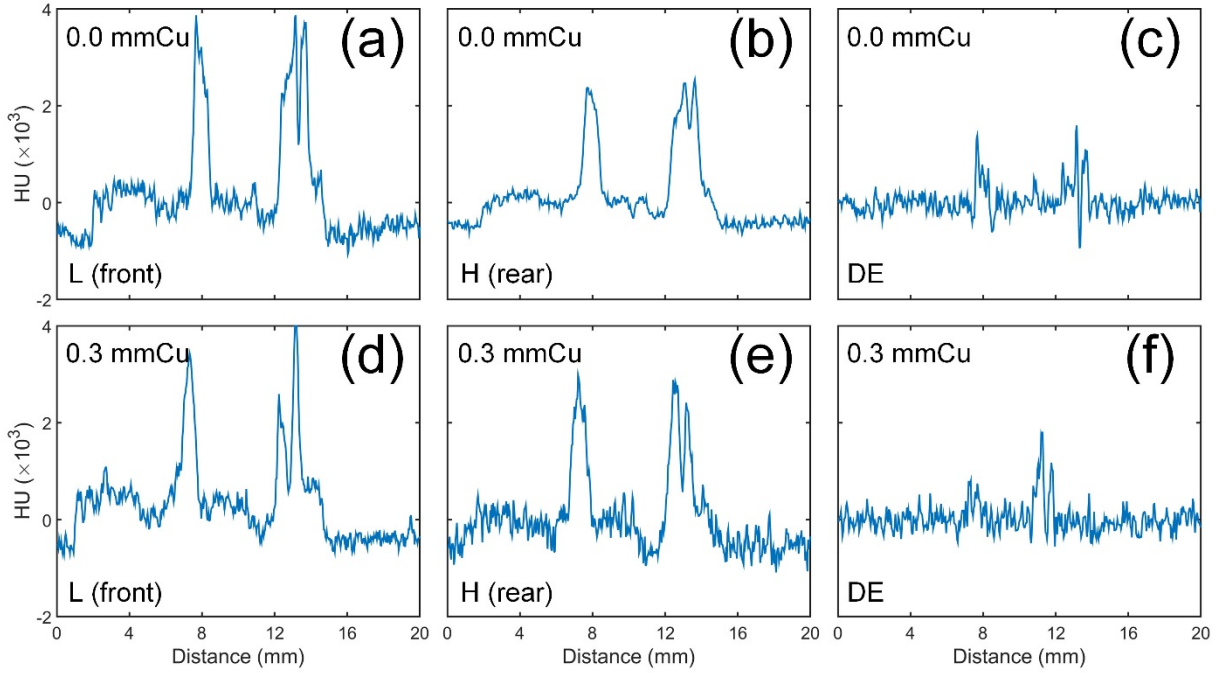

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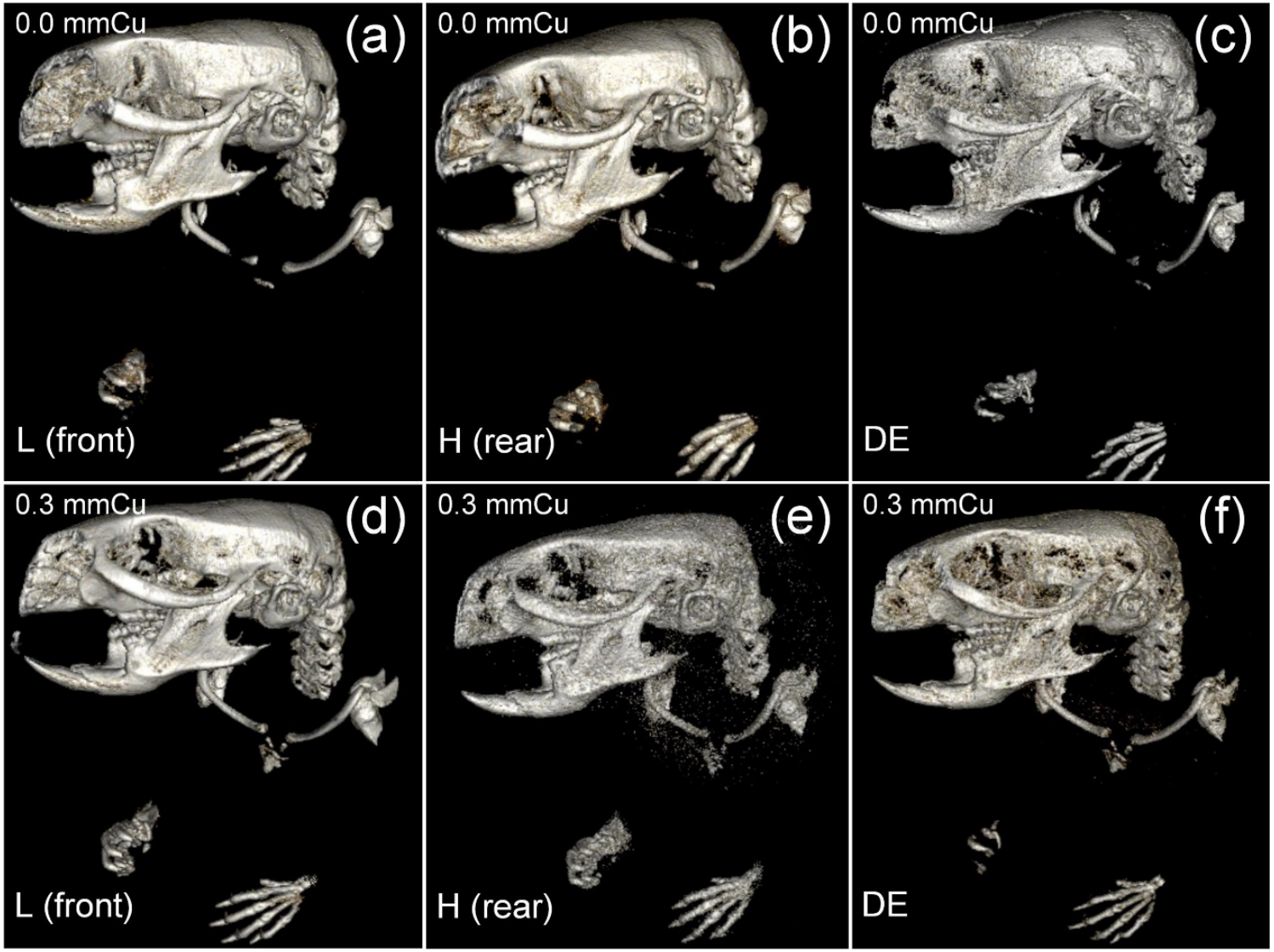

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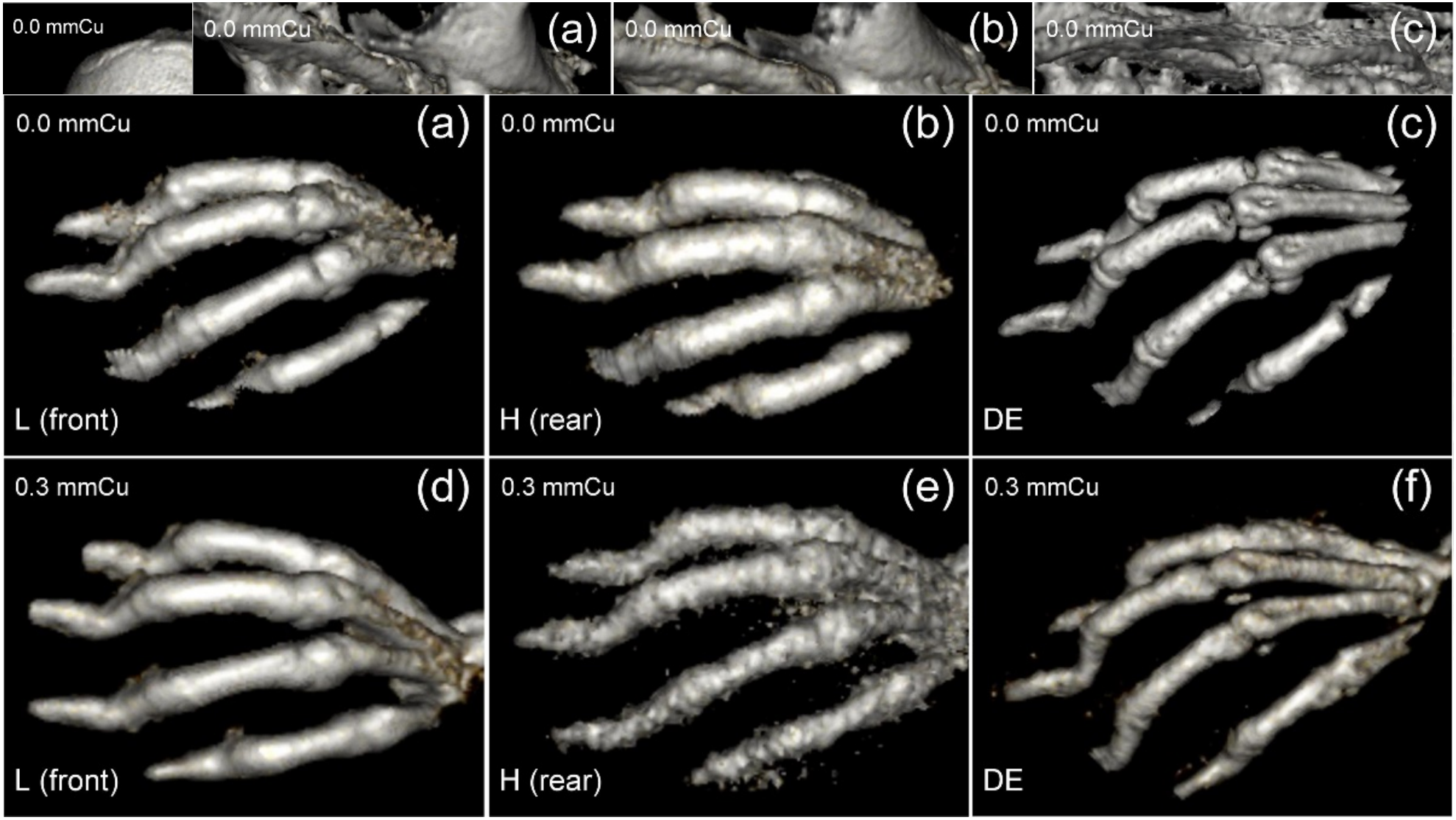

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Conclusion

- We have successfully demonstrated a high-resolution microtomography using a multilayer detector.

- The subtraction between two images with different spatial resolution properties provides a sharpened image due to the unsharp-masking-like effect, hence the image sharpness in the reconstructed images is much improved.

- Although use of an intermediate filter, which is placed between the front and rear flat-panel detectors, results in less residual soft tissues in the reconstructed bone-enhanced images, it degrades the visual image quality of bone details because of increased noise.

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Further study

- Optimal filter design in terms of material and thickness is required for a more tissue separability and less noise performance in images.
- It is needed that quantification of the image quality compares the bone-enhanced image with conventional image.
  - (MTF, NPS, NEQ)
- We will analyze the differences between bone-enhanced images obtained from the projection- and recon-based approaches.

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Thanks for your attention

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