**Frequency boosting for the AAPM MAR dataset generation**

When using existing clinical images as software phantom in CT simulations and reconstructions, some blur is introduced in the process, and the simulated-reconstructed image does not look identical to the original clinical image. For example, in Fig 1 (c), the difference between the original image in Fig 1(a) and the reconstructed image in Fig 1(b) shows obvious high frequency components.

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| (a) | (b) | (c) |
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Fig 1. (a) original image (b) reconstructed image from CatSim simulation (c) difference between (a) and (b). Display W/L: 1000/0

To minimize that discrepancy, we developed and optimized a frequency-based blur compensation algorithm to minimize the pixelwise error before and after CT simulation and reconstruction. Fig 2 (a) shows the radial averaged frequency components of Fig 1(a) and (b), and their ratio is displayed in Fig 2(b). This ratio is applied in 2D Fourier space as shown in Fig. 2(c), to compensate frequency loss in CatSim simulations. The frequency boosting ratio is calculated for each individual image.

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| (a) | (b) | (c) |
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Fig 2. (a) Radial average of FFTs (original & recon) (b) Ratio of radial average FFTs (original/recon) (c) Filter in 2D frequency space.

Fig 3 (a) shows the frequency boosted image, and Fig 3(b) shows the difference between the original image in Fig 1(a) and reconstructed image with CatSim simulation in Fig 3(a). It shows that high frequency components in Fig 1(c) have been greatly reduced.

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| (a) | (b) |
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Fig 3. (a) frequency boosted images (b) difference between Fig. 1 (a) and Fig. 3 (a). Display W/L: 1000/0

References:

[1] Fan, Ying, Jed Pack, and Bruno De Man. "A virtual imaging trial framework to study cardiac CT blooming artifacts." 7th International Conference on Image Formation in X-Ray Computed Tomography. Vol. 12304. SPIE, 2022.