Fast De-streaking Method Using Plain Neural Network

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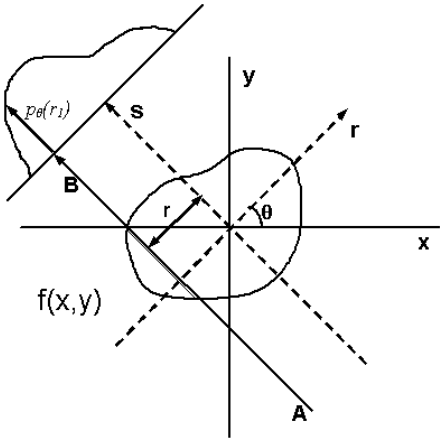
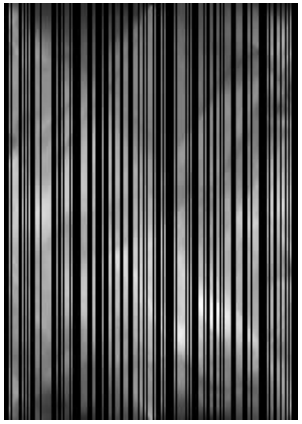
Radon reconstruction

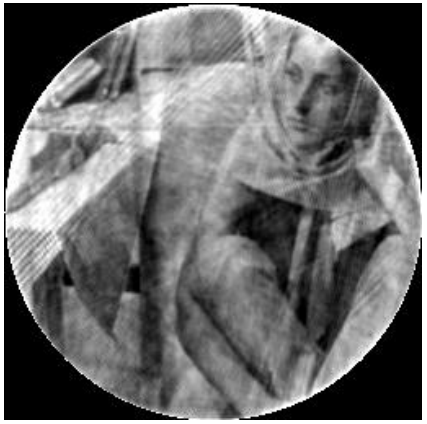
An image restoration task

- Radon transform
  - Line integrals -> sinogram
- Filtered back projection -> streaks
- Compressive sensing



Tomographic @ Wikimedia Commons





Reference

Noisy reconstruction

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Neural network

From machine learning to image restoration

Clean image C

Corruption

Restoration

Corrupted image Y

Recovered image $\hat{C}$

$\hat{C} = f(Y)$

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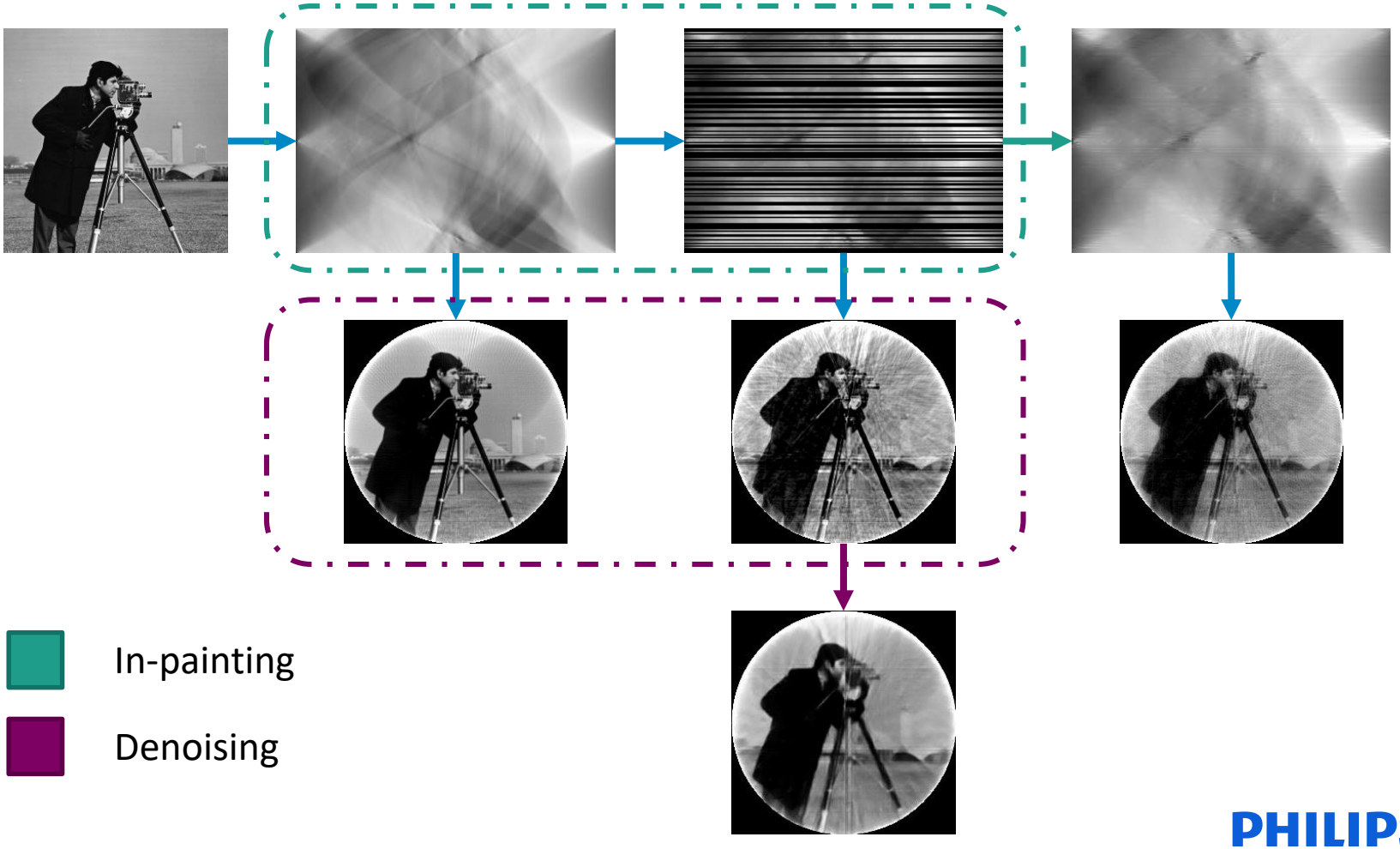
All possible approaches

In-painting and denoising (de-streaking)



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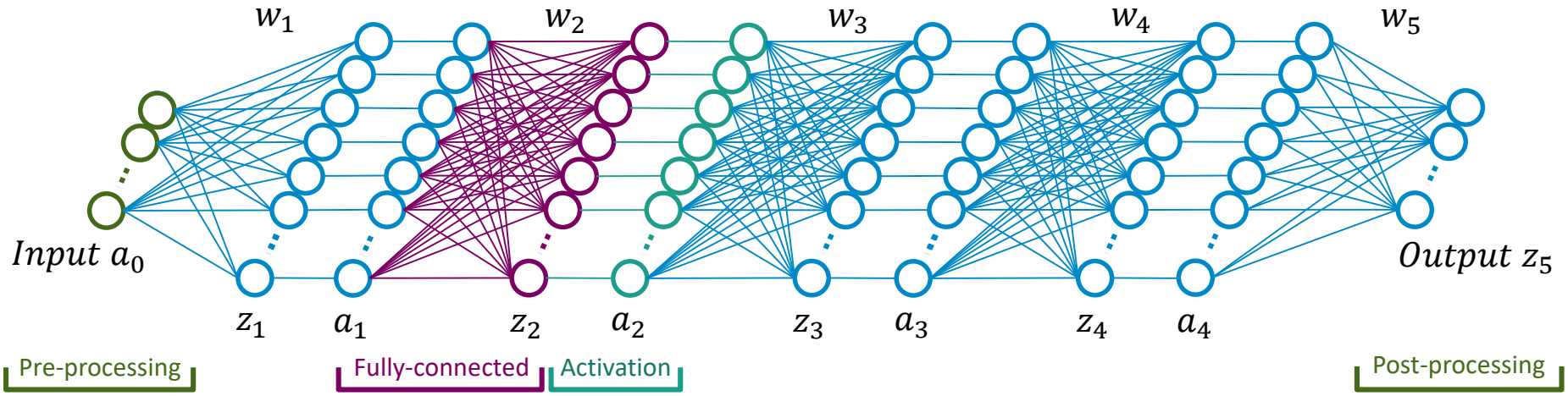
Neural network

What is that?



- **Plain neural network** (also called **M**ulti **L**ayer **P**erceptrons)
- Convolutional neural network
- Recurrent network

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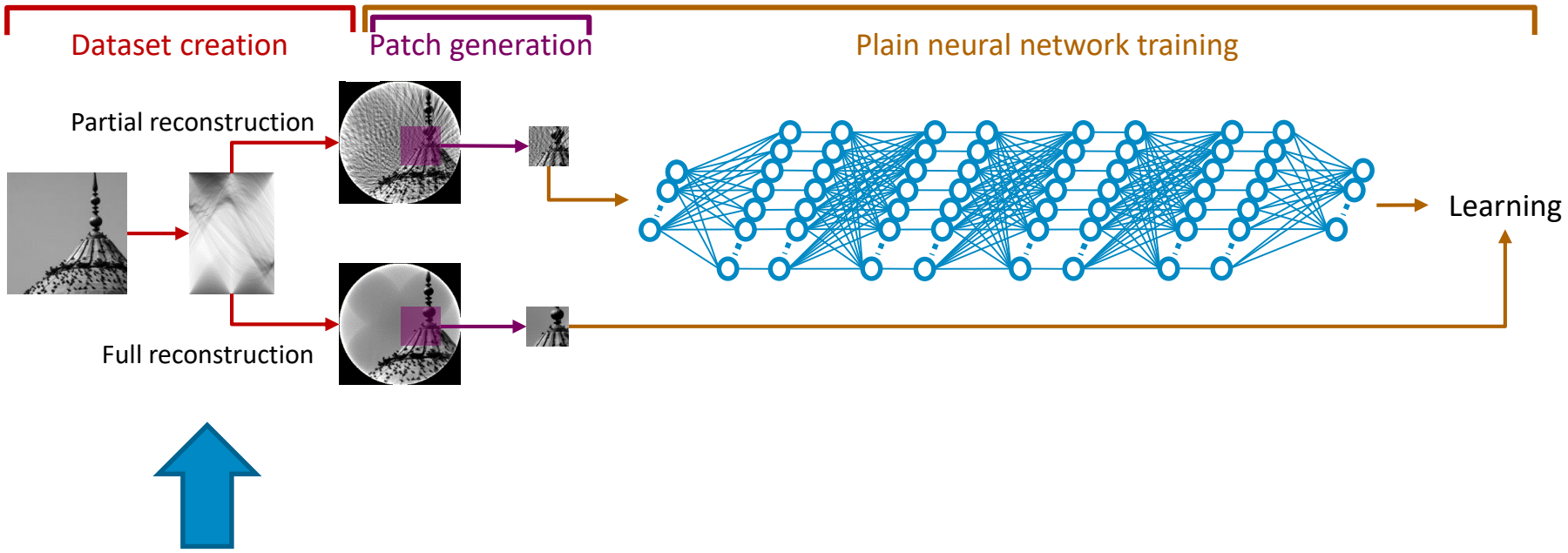
Network training

Dataset generation and reconstruction method

- ImageNet
  - Precomputed clean and noisy training pairs



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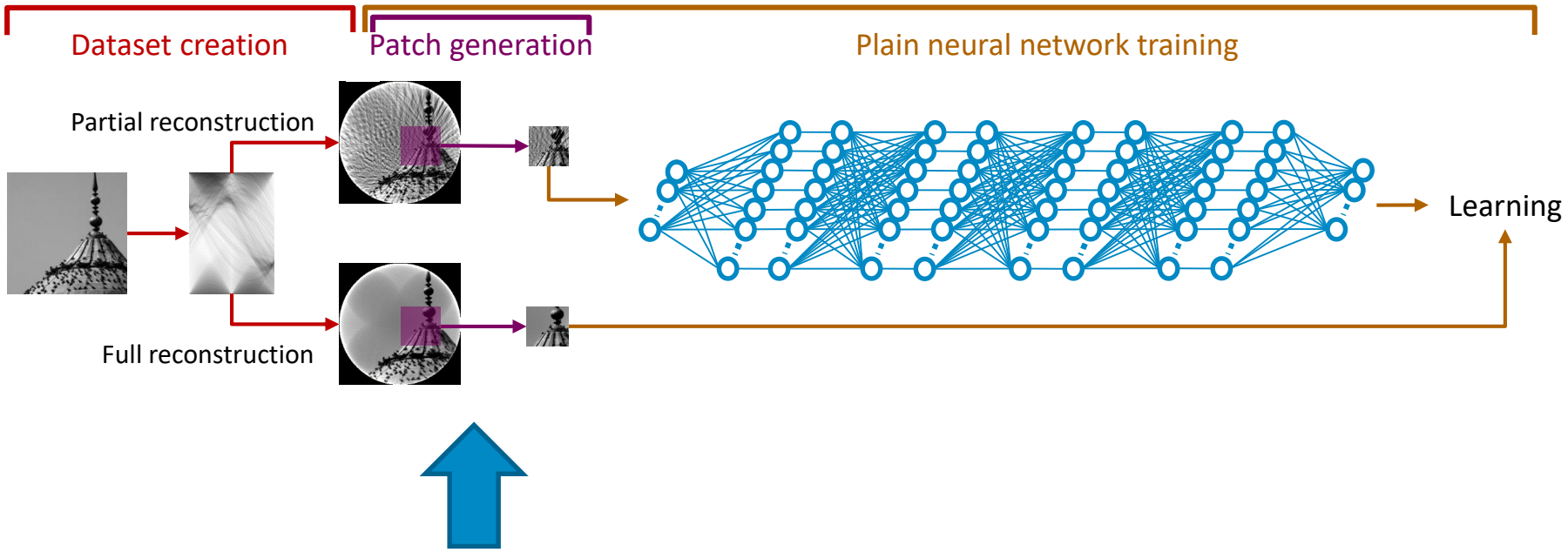
Network training

Dataset generation and reconstruction method

- Take a 17*17 patch at a random position



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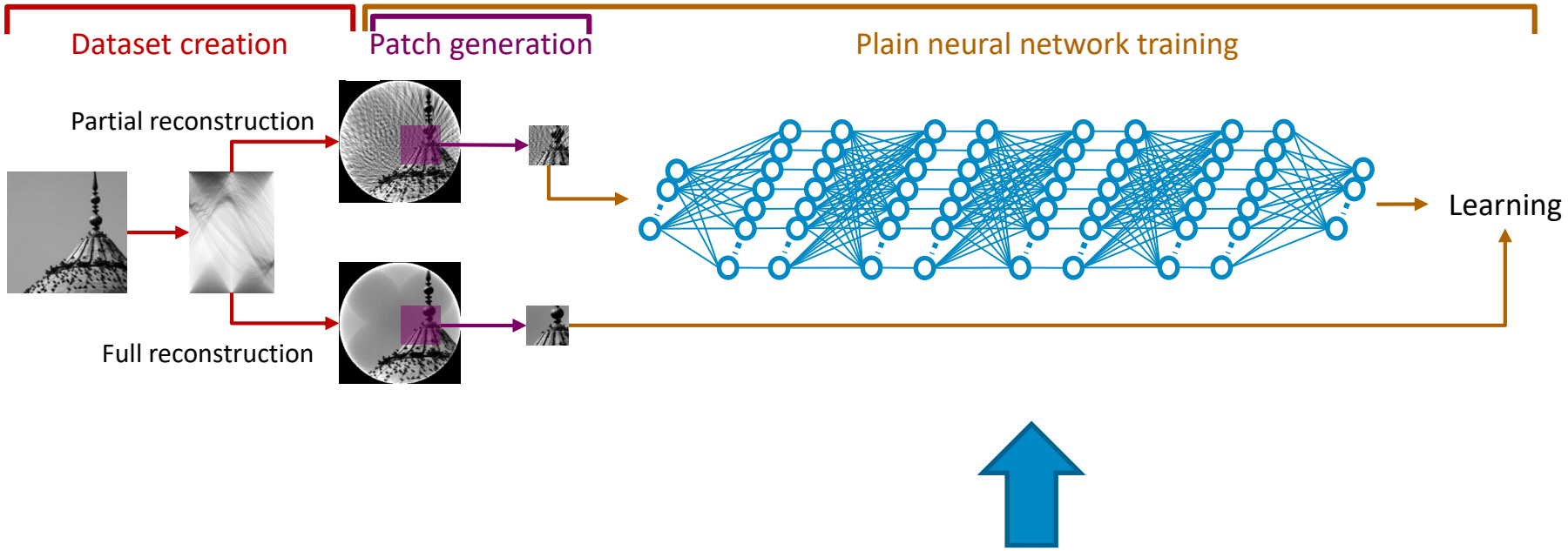
Network training

Dataset generation and reconstruction method

- 4-layer neural network (Burger et al. 2012)
- 2047 neurons in the hidden layers, 249 neurons in the output layer



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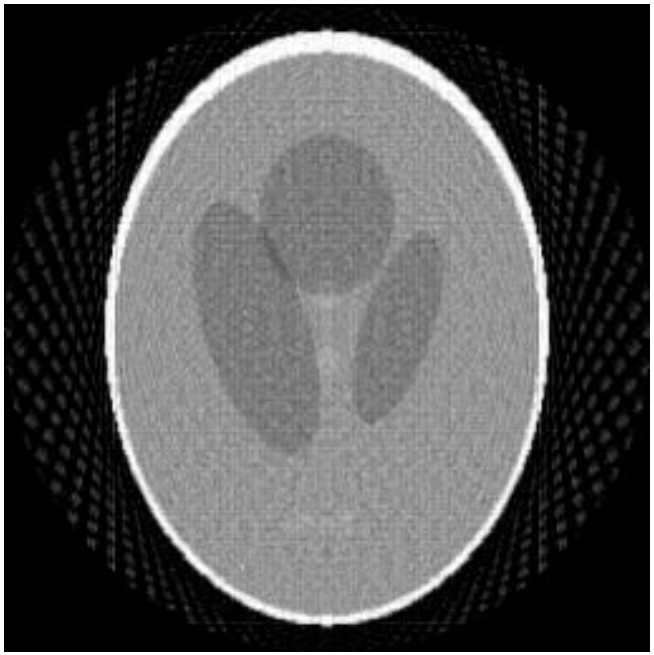
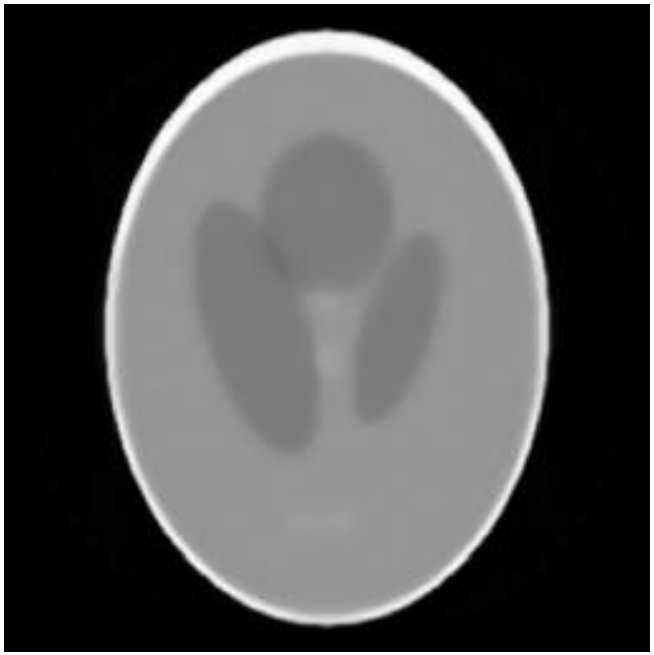
Result

20% angles, phantom





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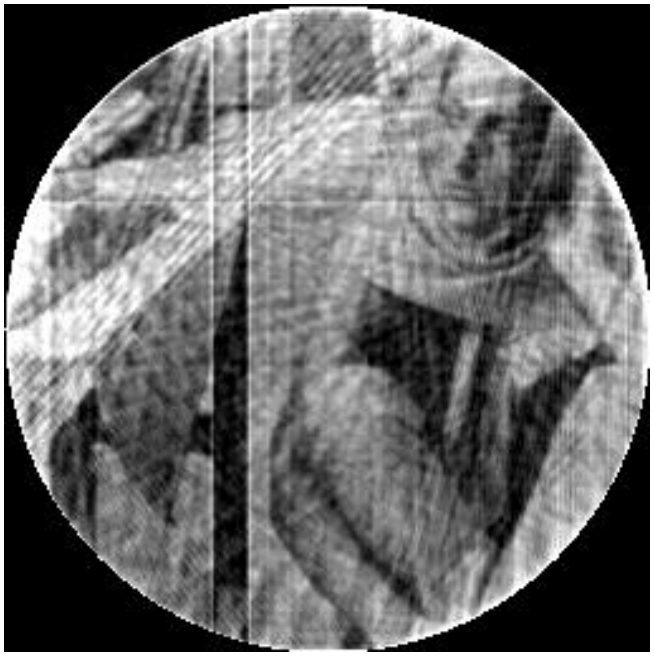
Results

20% angles, barbara



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Results

50% angles, barbara

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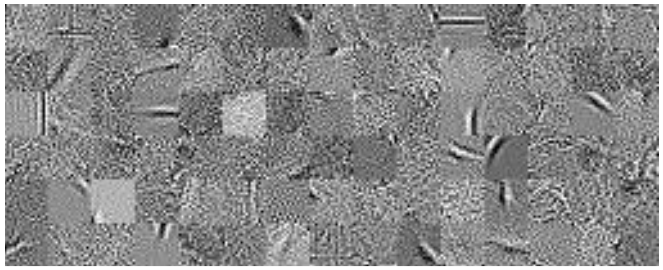
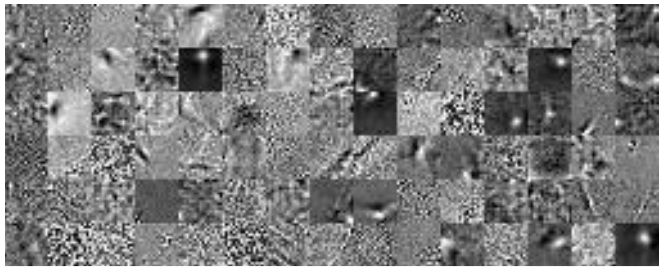
Results

Feature maps

- Input features



- Output features



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Discussions

De-streaking approach

- Advantages
  - Faster than iterative method
  - Works better when the number of missing angles is large
  - Only requires an input in the image domain
- Disadvantages
  - Information from sonogram are sometimes violated

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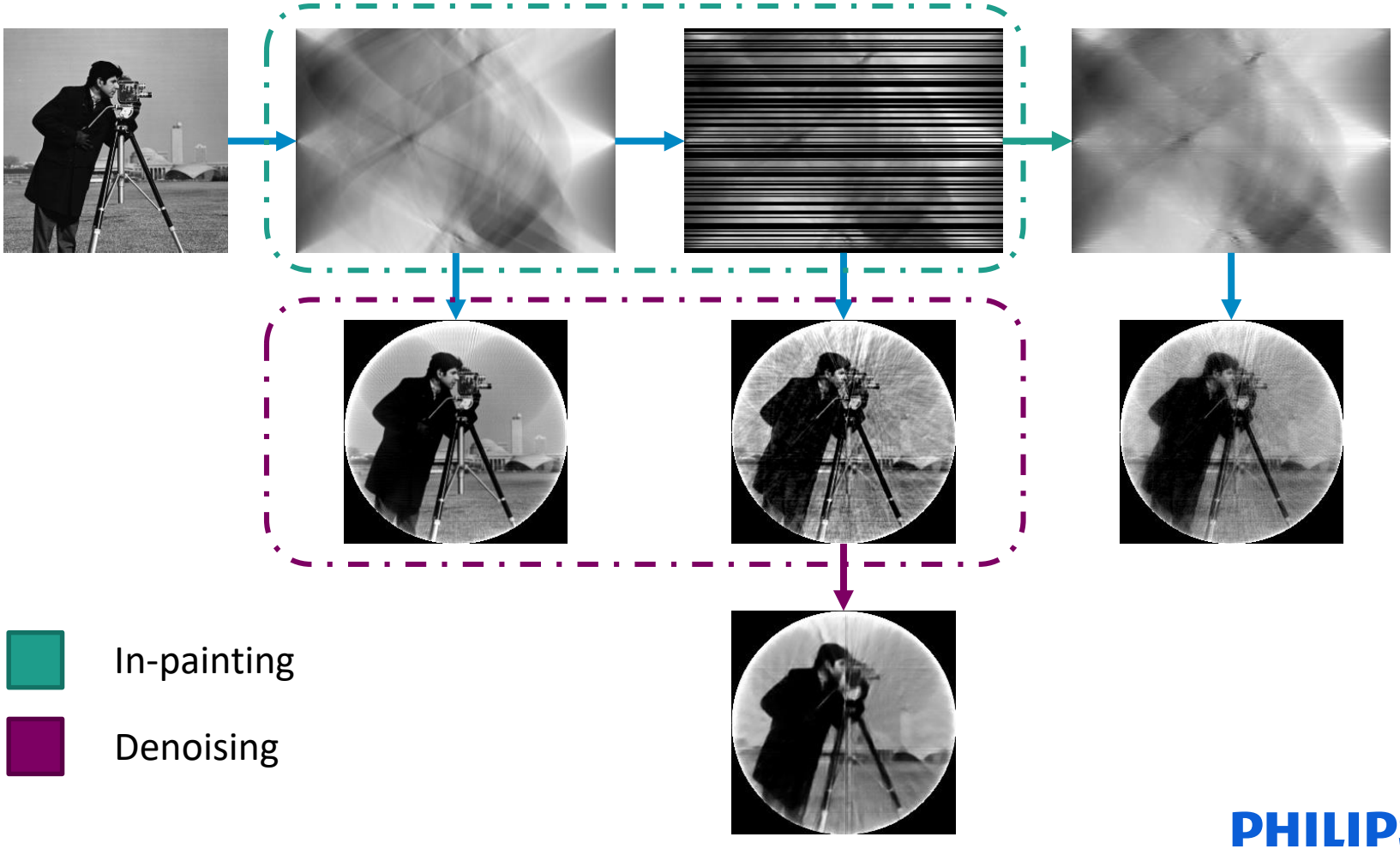
Discussions

In-painting and denoising (de-streaking)



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Conclusion

Future investigations

- What is the best neural network structure?
  - Convolutional layer on top of the whole image
- Is Mean Squared Error the best loss function?
- Would is possible to combine in-painting and de-streaking approach?

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