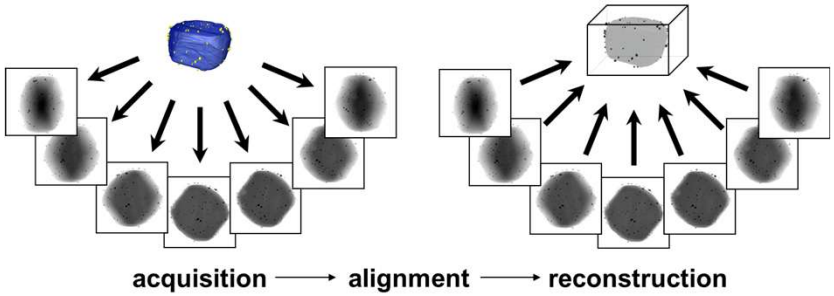
Image interpolation for improving process efficiency

X-ray tomography



Step 1: Image acquisition of the sample from different angles → Tilt series.

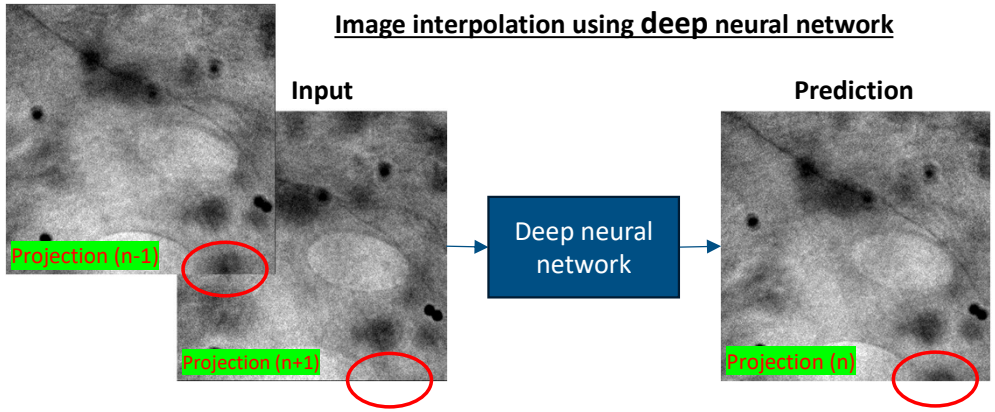
Step 2: Alignment of the tilt series.

Step 3: Tomogram construction from aligned tilt series.

Tilt series: projections {*1,…,n*} = projections {*even indices, odd indices*} = Even stack + Odd stacks

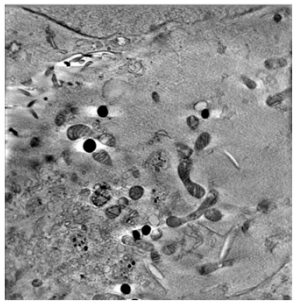
Goal:
Acquired from microscopy: Odd stack
Predicted from deep learning: Even stack

Image interpolation using deep neural network



Comparing tomogram section obtained from interpolated images with that obtained from raw images

Tomogram slice obtained from:
Even stack*:* interpolated
Odd stack**:** raw images



Tomogram slice obtained from:
Even stack: raw images
Odd stack**:** raw images

Take home message : Reduce image acquisition time and get a tomogram with 50% data that is comparable with 100% data.

Quantitative analysis - sFSC plots (Backup slide)

Fourier Shell Correlation (FSC) is the metric to find the similarity between two 3D volumes in Fourier domain. It is the normalized cross-correlation as a function of spatial frequency.

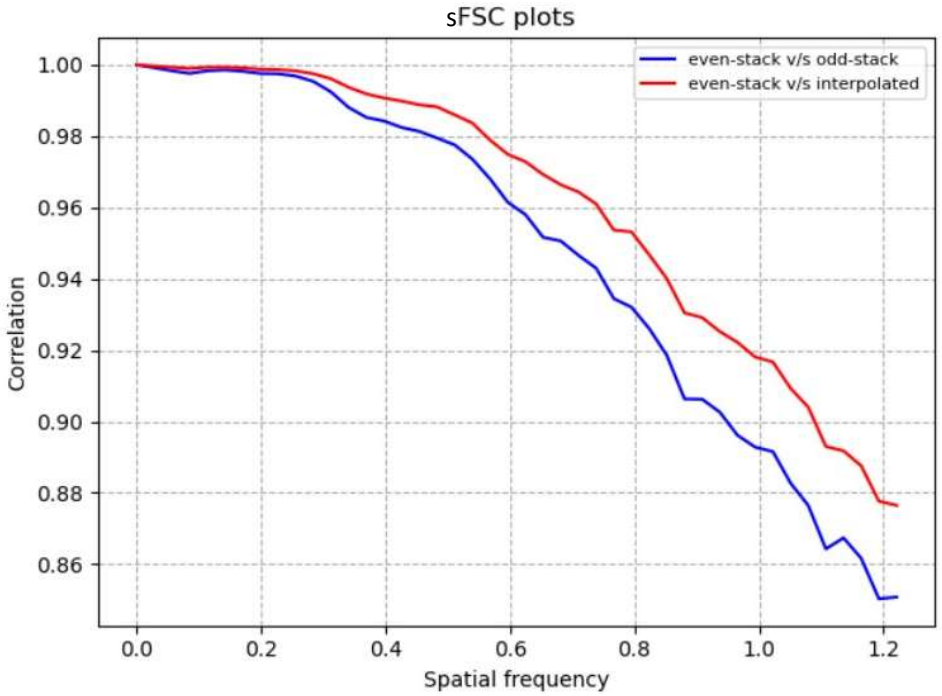
$$FSC(r) = \frac{\sum_{r_i \in r} F_1(r_i) \cdot F_2(r_i)^*}{\sqrt{\sum_{r_i \in r} |F_1(r_i)|^2 \cdot \sum_{r_i \in r} |F_2(r_i)|^2}}$$

F(r) – complex structure factor at position 'r' in Fourier space

'*' – represents complex conjugate

Findings:

- **Motion shifts** during reconstruction can result in the tomograms from even and the odd stack being shifted.
- FSC is not shift invariant → hence qualitative and quantitative results did not match.
- Now → sFSC was implemented with only magnitude component of the Fourier domain.



Note:

Interpolated:

- Raw images were used for the odd stack
- Interpolated images were used for the even stack

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Thank you for your attention!

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