Live ptychography

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Ptychography allows the transmission function of an object to be determined from scanning diffraction data acquired under suitable imaging conditions. Interest in electron and X-ray ptychography is growing since it offers a number of advantages over other imaging methods, including the ability to record electron phase contrast from both light and heavy atoms quantitatively.

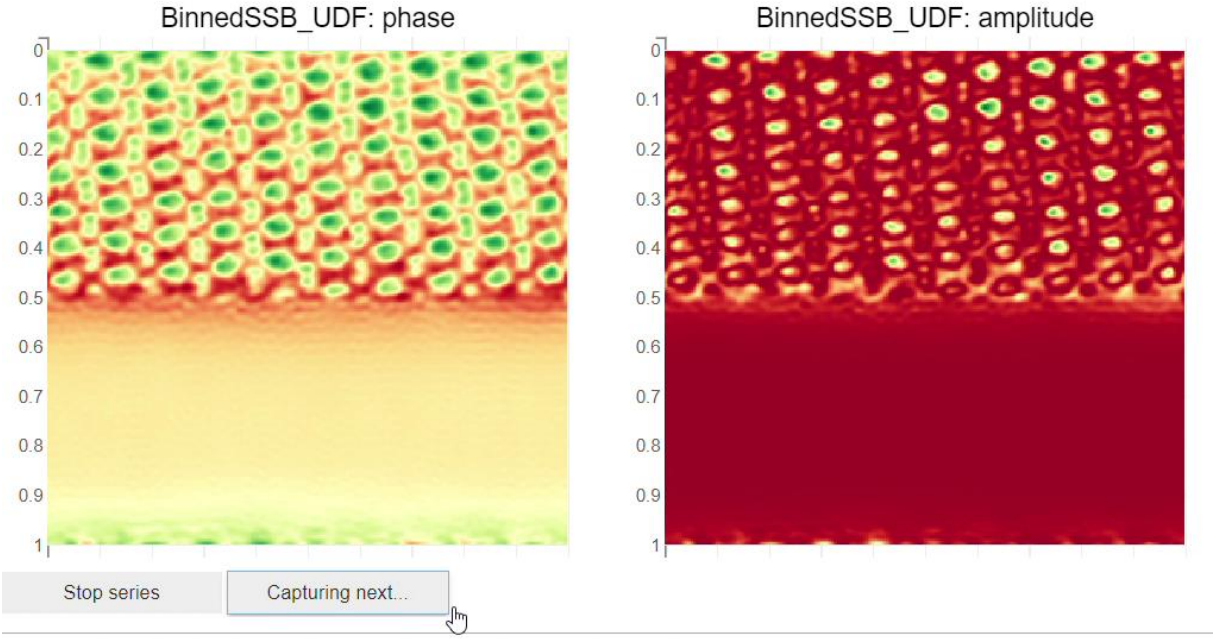

Figure 1. Snapshot of live SSB reconstruction [1] of SmB_6 viewed along the <110> zone axis in a scanning transmission electron microscope with prototype integration in an acquisition workflow using simple graphical user interface components.

Conventionally, an object transmission function is reconstructed from offline data using a stand-alone software or script. In scanning transmission electron microscopy, a ptychographic reconstruction is more sensitive to the alignment of the specimen and instrument than, for example, high-angle annular dark-field contrast, while also requiring a suitable choice of optical and reconstruction parameters. Direct reconstruction feedback at the instrument can be used to ensure that measurements are suitable by making live adjustments until the result is satisfactory.

Here, we demonstrate live reconstruction using different algorithms for ptychography and integration in experimental workflows performed at electron and X-ray microscopes [3], including live parameter adjustment and closed-loop feedback.

We show how both direct and iterative ptychographic reconstruction methods can be adapted to live processing. This approach requires a suitable mathematical reformulation, performance engineering to deal with the rate of incoming data, a suitable application programming interface for the reconstruction engine, and tools such as the LiberTEM framework [2] for receiving live data, processing and visualization.

References

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