



DE-FREESCAN

Flexible Scan Generator for STEM

OPTIMIZED FOR

**MISSION CONTROL
+ DIMENSION MODULE**

Delivering Bigger | Better | Faster | Cameras For Electron Microscopy

CUSTOMIZABLE SCAN GENERATOR FOR ADVANCED APPLICATIONS

- Completely customizable scan patterns, including snake, spiral, alternating rows, checkerboard, subsampled, etc.

Raster



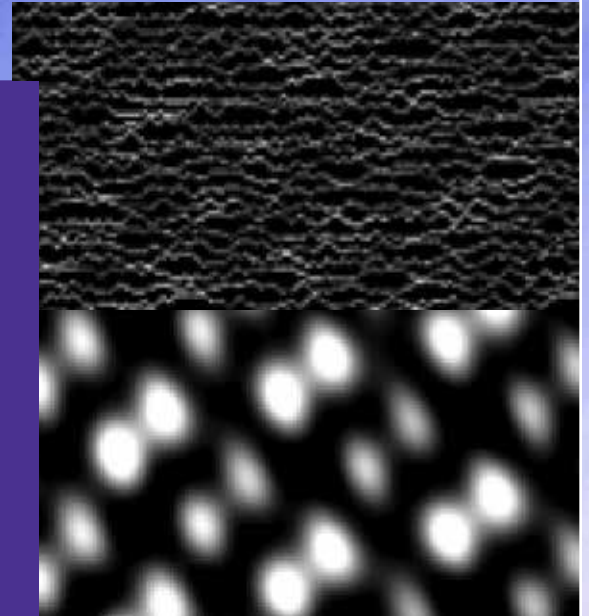
Serpentine



Spiral



- Synchronizes with the camera through Mission Control and Dimension to enable seamless 4D-STEM and ptychography.
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- Scan areas covering up to $8k \times 8k$ pixels.
- Four analog inputs with simultaneous acquisition for conventional STEM detectors (e.g., BF, ADF, HAADF, etc.).
- Automatic averaging of multiple high-speed samples of each analog input to maximize SNR.
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- Compatible with most STEM microscopes.

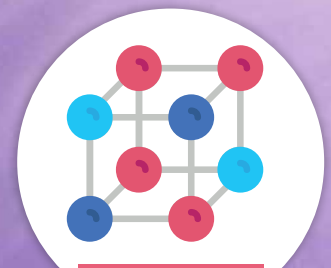


Subsampled STEM acquisition (top) and atomic-resolution reconstruction (bottom) of NiTiO₃. Courtesy of Andrew Stevens (Duke University, Durham, NC USA) and Nigel Browning (Pacific Northwest National Laboratory, Richland, WA, USA).

DETECTOR APPLICATIONS:



Biology



Materials

Direct Electron
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Our custom-developed DE-FreeScan scan generator was originally developed in collaboration with academic laboratories researching compressive sensing applications for scanning transmission electron microscopy (STEM). To pursue this research, investigators required the ability to arbitrarily change the scan patterns so that various subsampling strategies could be evaluated. As a result of this collaboration, DirectElectron developed the DE-FreeScan scan generator.

In addition to subsampling and compressive sensing, the flexibility of the DE-FreeScan enables users to evaluate and use non-standard scan patterns to potentially accomplish other goals such as minimizing specimen charging or reducing image distortions.

While the DE-FreeScan works well with conventional analog STEM detectors to enable customizable STEM scan patterns, it is most powerful when paired with Direct Electron's direct detection camera systems.

DE-FreeScan is the optimal accessory for enabling 4D-STEM using Direct Electron's cameras. 4D-STEM enables a wide range of analysis techniques, including ptychography (for phasecontrast), orientation mapping, magnetic-field mapping, and elemental discrimination.

To perform 4D-STEM experiments optimally and without significant image artifacts, the pixelated 4D-STEM detector must deliver:

- **High speed:** Thousands of diffraction patterns per second.
- **High sensitivity:** Very high single-electron signal-to-noise ratio (SNR) to capture the low-intensity dark-field signal.
- **High dynamic range:** Reliably capture both low- and high-intensity features each diffraction pattern.
- **Global shutter:** Synchronously reading and resetting all pixels in the detector so that captured diffraction patterns are NOT mixtures of multiple probe positions.

Direct Electron's DDD® Camera Systems are the only available direct detection camera satisfying all four of these requirements for optimal 4D-STEM acquisition.