Section 0.1.3 Noise Correction in TEM/STEM

Sources of Noise

There can be many sources of noise in TEM/STEM

- Shot noise- from fundamental Physics. Dominant in STEM. It arises from the statistical fluctuations in the number of incident electrons and electron scattering events.
- Detector/Read noise. Variations in the electronics of the detectors in the microscope
- Room temperature variations,
- Variations in the accelerating voltage of the microscope
- Sample modifications (from beam damage or instabilities under the beam, etc)
- Scan jitter (of the e-beam)
- Sample DRIF

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Noise Correction with Gaussian Filter

- Gaussian Filter reduces Gaussian noise by deconvolution of a Gaussian (bell shaped curve) with the image to diminish high frequency noise.
- It is a form of weighted average of pixels around each pixel.
- The center pixel is averaged by 3x3, 5x5, etc pixels (kernel size) with a standard deviation σ .
- This creates smoother transition but if σ is high it can reduce sharpness.

Gaussian noise has a probability density distribution with Gaussian shape. It is usually low.

$$p(z) = \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{(z-\mu)^2}{2\sigma^2}}$$

z: grey level, μ mean grey value, and σ standard deviation

Need to correct noise before making measurements to have more accurate values.