PIAAA:
Advanced Metrics

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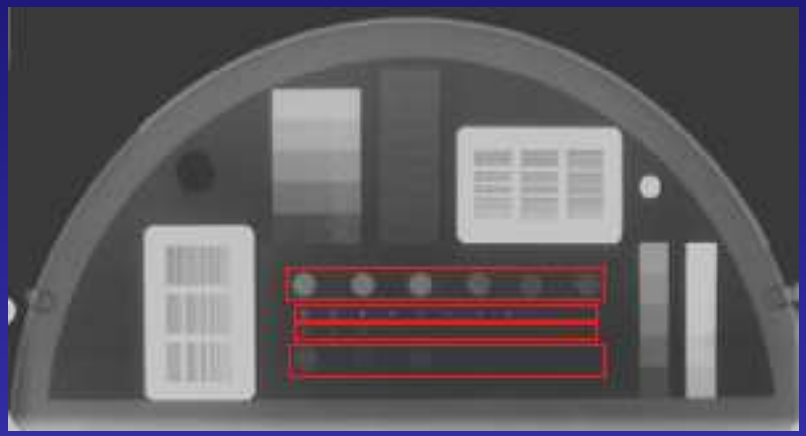
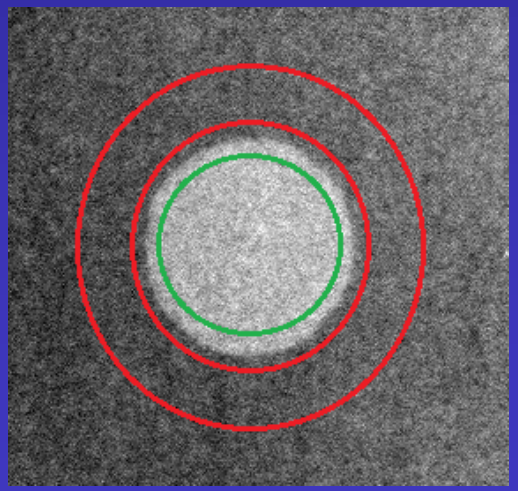
Contrast-to-Noise Ratio





- Used for
  - Large details with low contrast
  - Small details with high contrast
- $$CNR = \frac{\left| S_{\text{detail}} - S_{\text{bkg}} \right|}{\sigma_{\text{bkg}}}$$
- Where
  - S_{detail} is the signal produced by the detail, which is the mean grey level of the detail (green circle)
  - S_{bkg} is the signal of background (red annulus)
  - σ_{bkc} is the variance of the background

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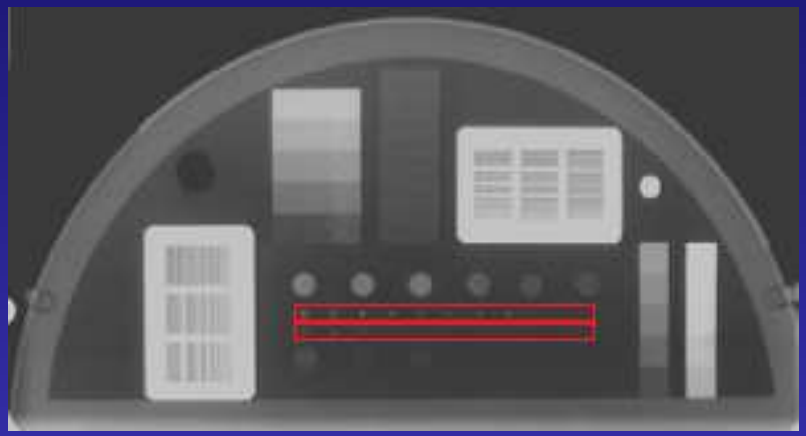
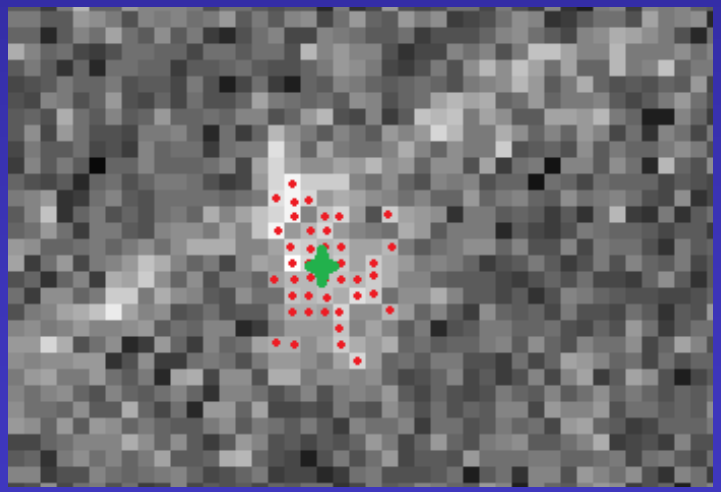
Detail Compact Contrast





- Used for
  - Small details with high contrast
- $$DCC = \frac{\sum_i PCNR_i \cdot w_i}{\sum_i w_i}$$
- Where
  - i index of bright pixels belonging to the small detail
  - $PCNR_i$ contrast-to-noise ratio produced by the pixel i (red)
  - w_i the weighting factor depending on the distance of the pixel i from the brightness barycentre (green)

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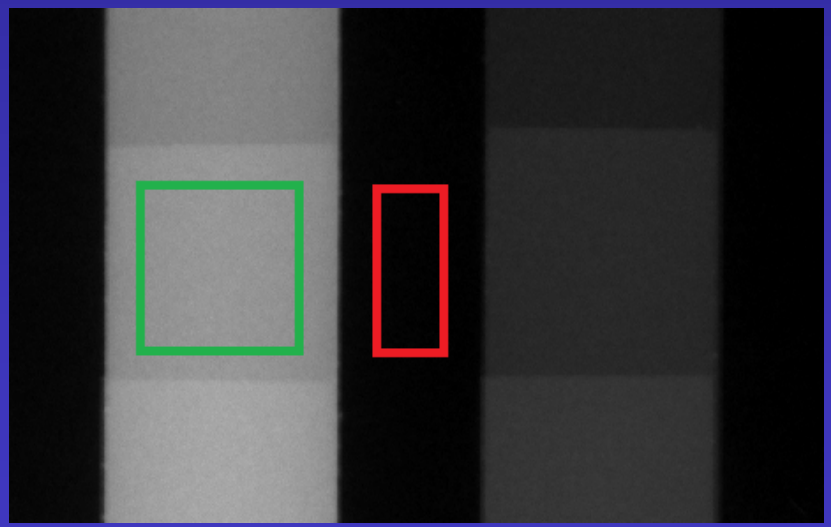
Relative Contrast



- Used for
  - Uniform step-wedges
- $$C_{SW} = \frac{\left|S_{\text{detail}} - S_{\text{bkg}}\right|}{S_{\text{bkg}}} \cdot 100$$
- Where
  - S_{detail} is the signal produced by the detail, i.e. the mean grey level of the detail (green)
  - S_{bkg} is the signal of background (red)

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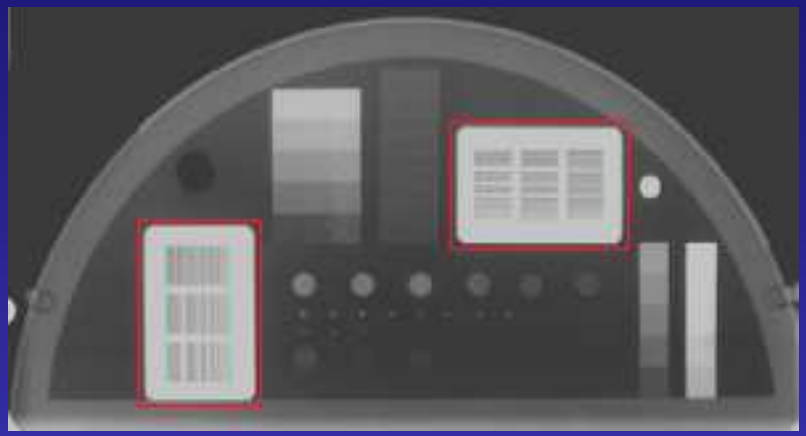
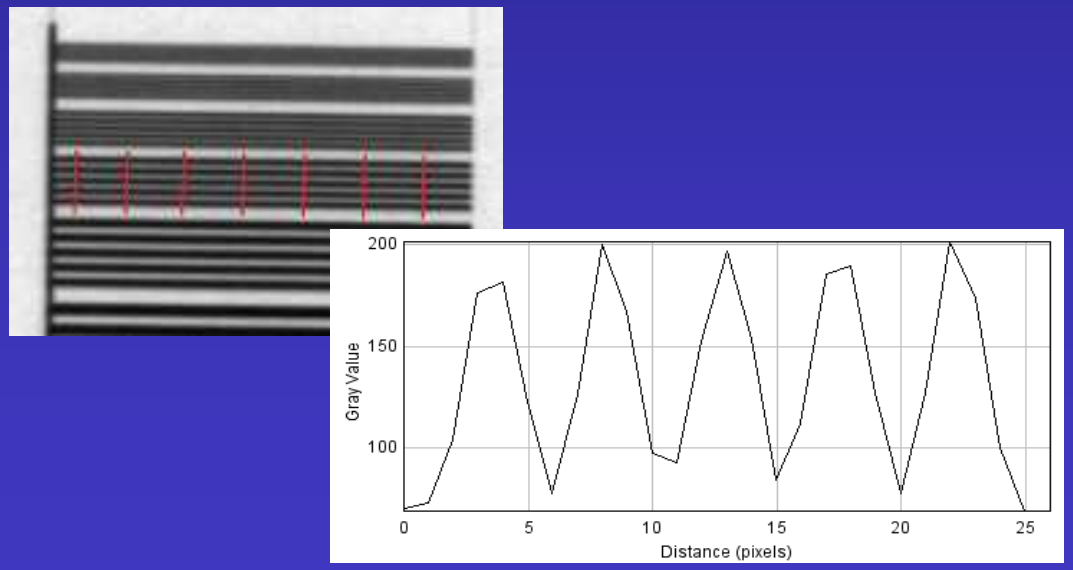
Modulation of the Lowest Frequencies Bars





- Used for
  - High contrast resolution gratings
- Quantitative spatial resolution could be obtained by determining the square-wave response function from modulation measurements at different spatial frequencies
- $$Mod = \frac{S_{\max} - S_{\min}}{S_{\max} + S_{\min}}$$
- Where
  - S_{min} and S_{max} are maximum and minimum signals corresponding to black and white bars on profiles (red)

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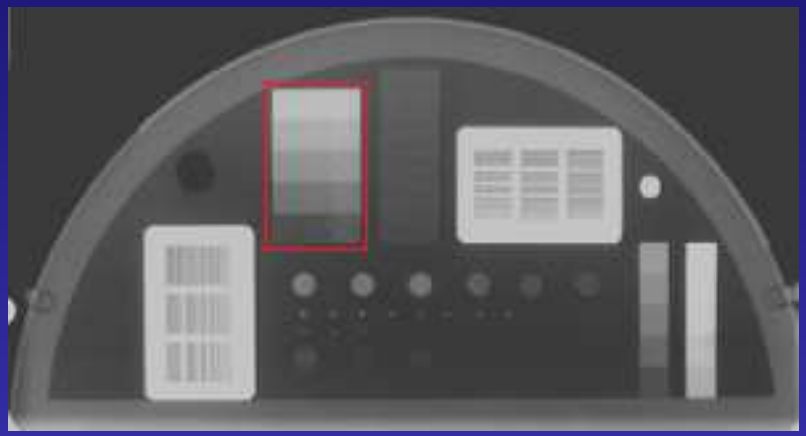
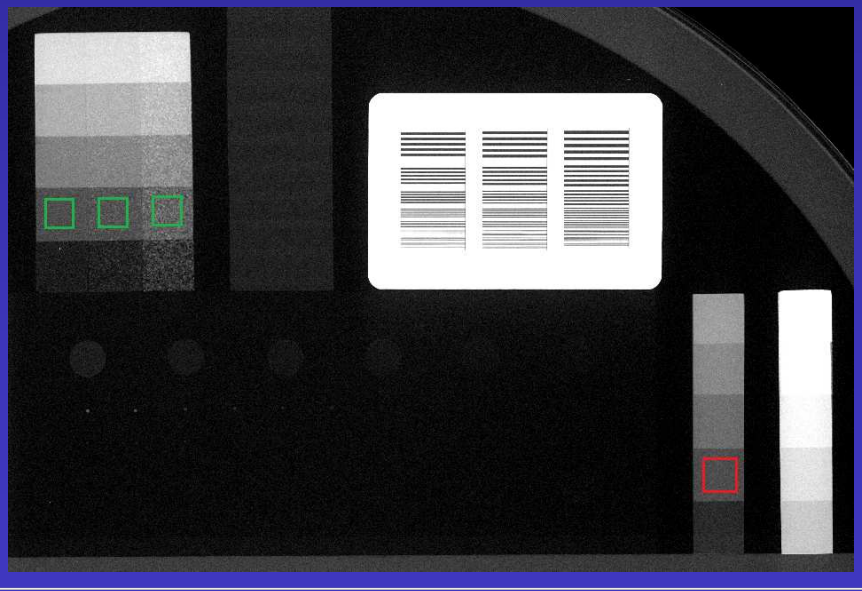
Ratio Between Variance of Micro Particle and Uniform Step Wedges





- Used for
  - Micro particle step wedges
- $$R_{\mu Part} = 1 + \frac{\sigma^2_{\text{structured}}}{\sigma^2_{\text{quantum}}}$$
- Where
  - $\sigma_{structured}$ is the total variance of micro-particle step wedge (green)
  - $\sigma_{qquantum}$ is the quantum component of the variance which can be approximated by the total variance of uniform step wedge (red)

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