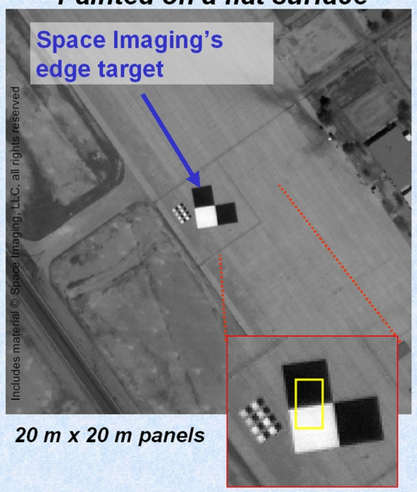
NASA Stennis Space Center

IKONOS Panchromatic Imagery Spatial Resolution Characterization

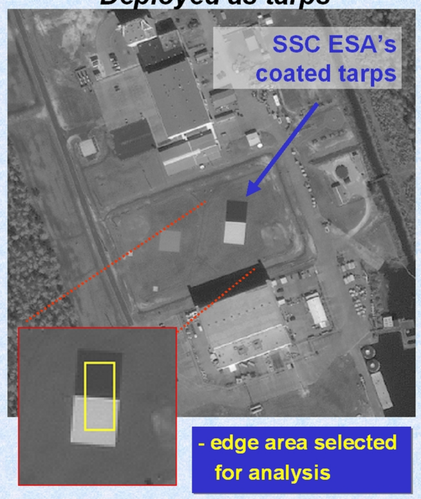
Edge targets are formed by adjacent black and white square panels:

Painted on a flat surface

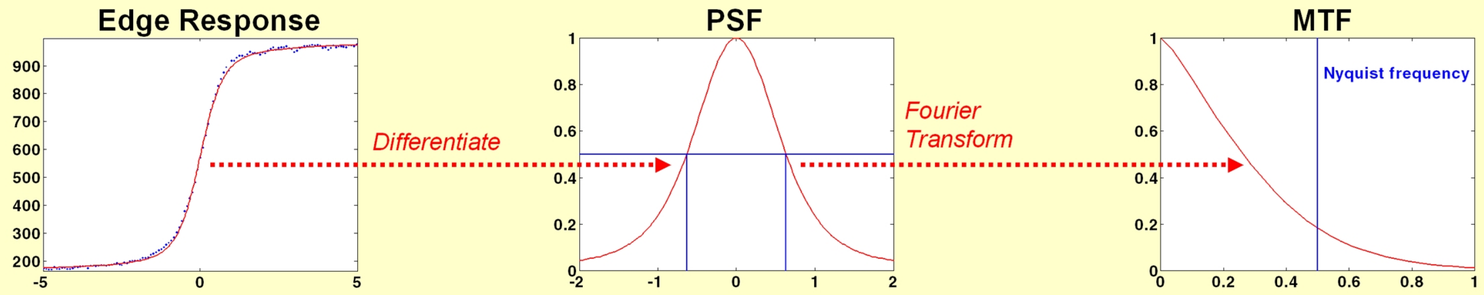


20 m x 20 m panels

Deployed as tarps



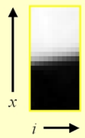
PSF and MTF Derivation



- **Finding position and orientation of the edge allows for shifting of the edge responses to a single reference location so that all the edge points are aligned.**
- **Superimposing all the shifted edge responses creates a new edge response with a finer spatial sampling.**
- **Optimized edge response is generated with arbitrary spatial resolution from the best-fit parameters.**

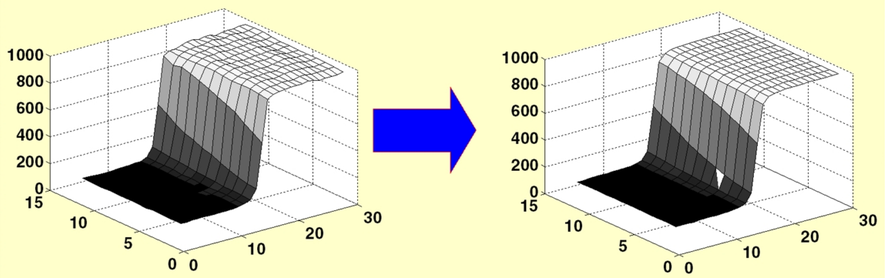
Modified Knife-Edge Technique

Selected edge area includes a set of edge responses, each with an edge position shifted by a fraction of a pixel from an adjacent response.



$$e_i(x) = d + \sum_{k=1}^{3} \frac{a_k}{1+\exp\left[\frac{b_1 \Delta i + b_2 - x}{c_k}\right]}$$

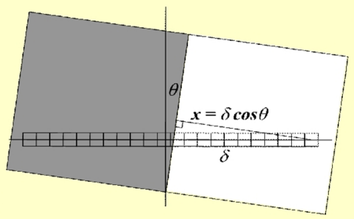
Nonlinear least-square fit of a two-dimensional function that is a linear combination of three sigmoidal functions

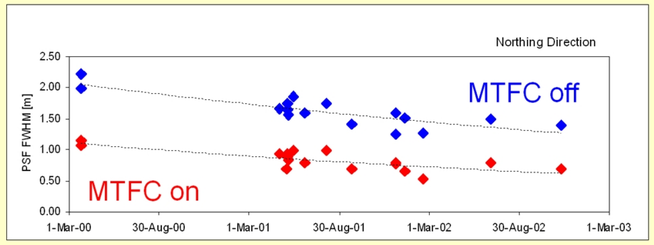


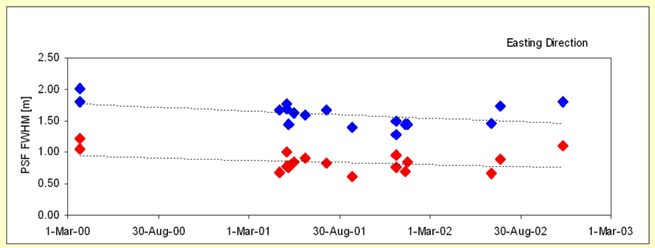
Actual intensity in the edge area

Best fit with the sigmoidal functions

- **Optimized parameters:** a_1, a_2, a_3, b_1, b_2, c_1, c_2, c_3, d
- **Position and orientation of the edge, described by parameters b_1 and b_2, are found *simultaneously* with the parameters characterizing spatial resolution (c_1, c_2, and c_3)**
- **Measured edge tilt:** $\theta = \tan^{-1}(b_1)$
- **Distance is scaled by cosine of the edge tilt angle:** $x = d\cos\theta$







Long-Term Observations

- **Images of edge targets acquired over a 3-year time period.**
- **Significant differences between the FWHM values obtained for different images, even if the images were acquired on the same day.**
- **No clear correlation between the observed FWHM and the image acquisition geometry (satellite elevation and azimuth angles).**
- **Temporal improvement in spatial resolution of IKONOS panchromatic images consistent with adjustments made to the IKONOS camera focus.**

MTF at Nyquist Frequency

- **There are significant differences between the MTF at Nyquist frequency values obtained for different images, even if the images were acquired on the same day.**
- **Most of the panchromatic images created without the MTF Compensation (MTFC) applied have the MTF at Nyquist frequency values below 0.15.**
- **Only the image products created with the MTFC applied have values of MTF at Nyquist frequency that clearly meet the NASA Scientific Data Purchase contract requirements.**