

# Geo/Spatial Quality Sub-Committee

## Report to IVOS

CEOS-WGCV-IVOS

March 16, 2017

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South Dakota State University  
Image Processing Lab

ONERA

# Proposed Framework

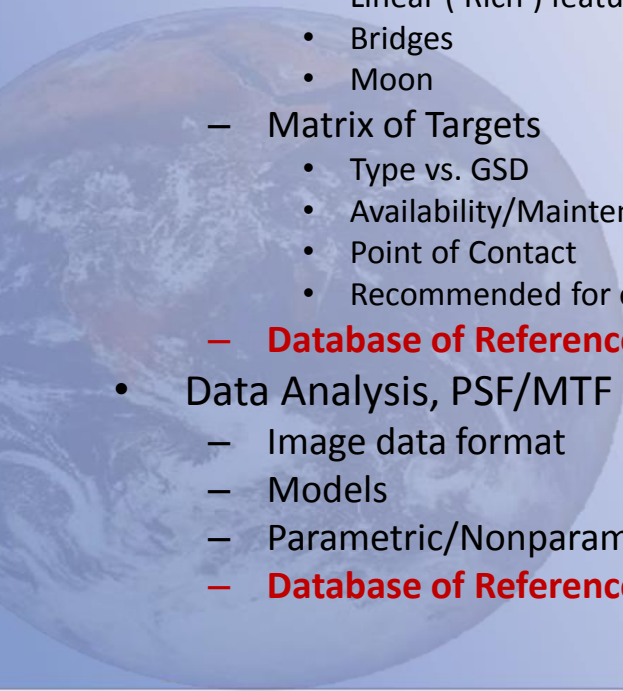
## On-orbit Estimation (substantial portion of document)

- **Field Methods Survey**
- Targets
  - Artificial/Man-made
    - Points
    - Lines
    - Edges
    - Pulses
  - Image feature-based
    - Linear ('Rich') features
    - Bridges
    - Moon
  - Matrix of Targets
    - Type vs. GSD
    - Availability/Maintenance
    - Point of Contact
    - Recommended for operational acquisition
  - **Database of Reference Imagery for PSF/MTF estimation**
- Data Analysis, PSF/MTF Estimation
  - Image data format
  - Models
  - Parametric/Nonparametric Methods
  - **Database of Reference estimation methods**

**Outcome was current  
Test Site Catalog**

**Current status: suite of  
edge images**

**This meeting's  
major activity**



# Test Site Catalog

- Test site catalog hosted by USGS EROS at [http://calval.cr.usgs.gov/rst-resources/sites\\_catalog/spatial-sites/](http://calval.cr.usgs.gov/rst-resources/sites_catalog/spatial-sites/)
- **No change in test site catalog** since our last meeting.
  - Checkerboards: Baotou, Big Spring, FGI Sjukulla, Peng-Hu, Salon de Provence, Stennis
  - Bridges: Chesapeake Bay, Jiaozhou Bay, King Fahd, Lake Ponchartrain, San Mateo
- Goal from last meeting to have exhaustive list of checkerboards and bridges
  - Are these lists exhaustive? If not, what is missing?
- Concern: how many of these sites are being maintained?
  - Maintenance is first requirement to be CEOS recommended

# Actions from Last Meeting

1. Francoise will circulate a desired data format; we will receive and comment. **Status: Completed**
2. All members will make a list of key parameters necessary for development of synthetic images. Submit to Dennis/Francoise, they will compile, organize to develop a final list. Included will be a range of values for the parameters. **Status: No Action**
3. D/F will consult with members of sub-committee to determine who is capable and willing to develop the second set of images. If possible, we will have images generated and available for processing. **Status: Open**
4. All members will share their methodologies and they will be listed at the next meetings. **Status: This Meeting's Activity**

# This Meeting's Major Activities

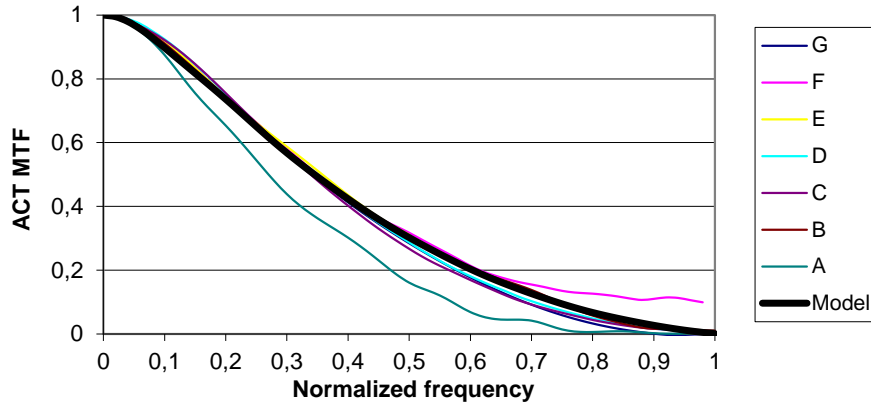
- Update of MTF Estimation Activity
- Presentations of MTF Estimation methodology for edge targets
- Discussion
  - Edge (checkerboard) MTF estimation methods
  - Develop database of standard edge target images, both simulated and actual.
  - Develop paper or report of efforts thus far

# Presentations

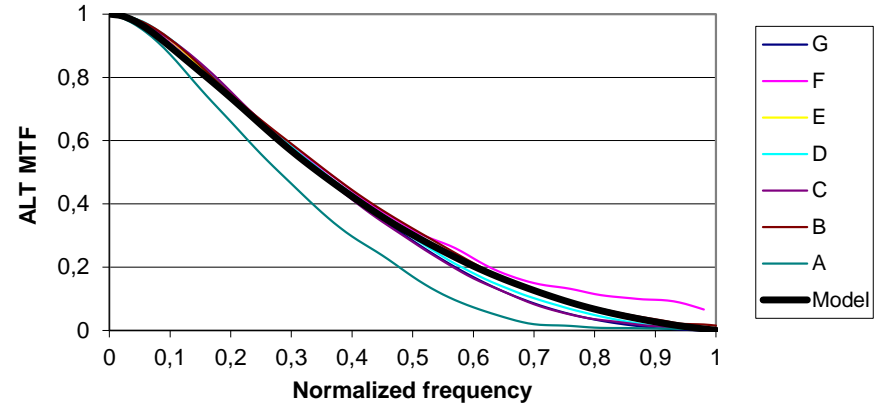
09:15	<b>Update of MTF measurements comparison</b>	Françoise Viallefont-Robinet (ONERA)
9:30	<b>Status of Edge target in worldwide by KOMPSAT-3</b>	DongHan Lee (KARI)
9:45	<b>Telespazio MTF measurement method</b>	Sébastien Saunier (TELESPAZIO)
10:00	<b>KARI MTF measurement method</b>	DongHan Lee (KARI)
10:15	<b>DIGITAL GLOBE MTF measurement method</b>	Amy Newbury (DIGITAL GLOBE)
10:45	<b>SDSU MTF measurement method</b>	Dennis Helder (SDSU)
11:00	<b>ONERA MTF measurement method</b>	Françoise Viallefont-Robinet (ONERA)
11:15	<b>Preparation of a paper and Discussion about coming work</b>	Françoise Viallefont-Robinet (ONERA) and Dennis Helder (SDSU)

# StdSystem\_1m : reprocessed by A, B, C and D

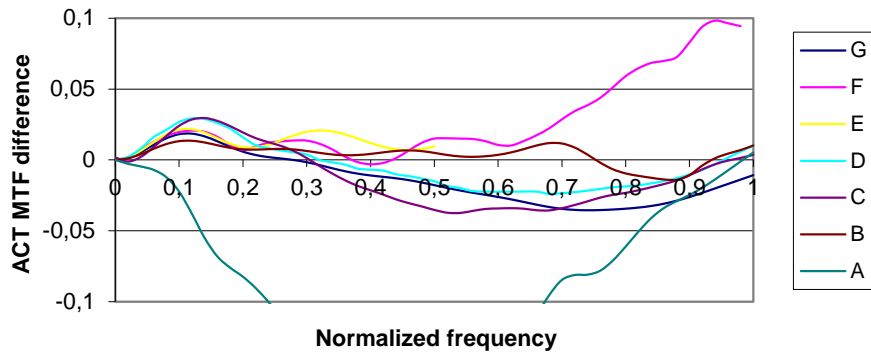
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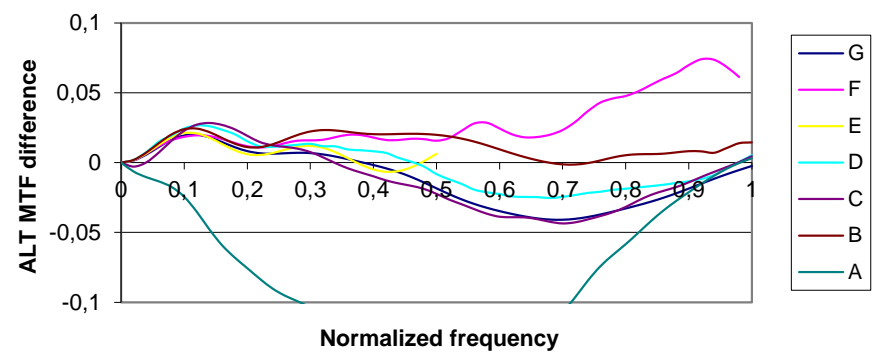
StdSystem\_1m\_F30\_B150



Deviation to the model  
StdSystem\_1m\_F30\_B150

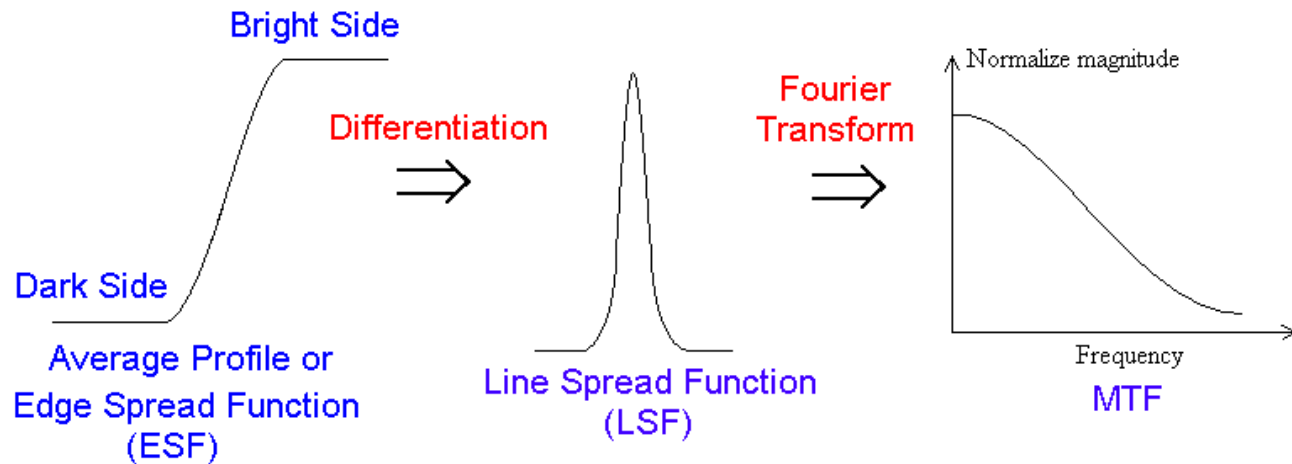
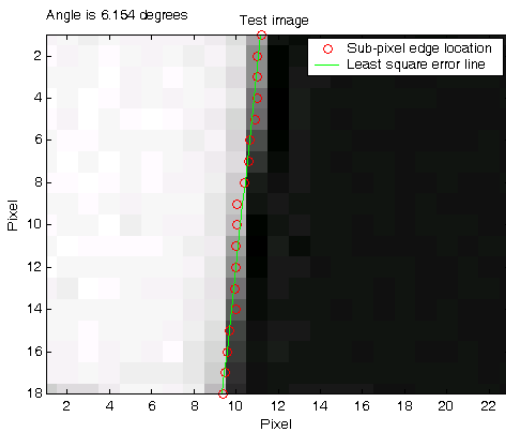


Deviation to the model  
StdSystem\_1m\_F30\_B150



# SDSU Edge Method Example

- Edge Method Steps
  1. Sub-pixel edge locations were found by Fermi function fit.
  2. A least-square error line was calculated through the edge locations.
  3. Modified Savitzky-Golay filtering was applied on each line.
  4. The filtered profile was differentiated to obtain LSF
  5. MTF calculated by applying Fourier transform to LSF.



Edge Method



# Meeting Results

- MTF Estimation Comparison
  - ‘Blind’ approach allowed participants to gain confidence in their methodologies through comparison with colleagues
  - Also allowed opportunity to assess accuracy and potentially discover errors and improve methodologies
  - Very comparable results with one or two outliers
- MTF Estimation Methodologies
  - Most methods use similar approach to obtaining PSF/MTF
  - However, differences exist that provide opportunities for comparison and potential improvements
  - All methods are viable approaches for estimating PSF/MTF from edge targets

# Next Major Steps

- First objective: a journal paper including all participants
  - Serves as a reference paper for this effort
  - Content: Methods, Estimates generated from 'High Priority Data', Discussion, Conclusions
  - Journal suggestions?
  - Writing organization
  - Mention of existing standards? (such as ISO 122233)
- Second objective: creation of a first reference dataset based on six 'High Priority Data' images
  - Create a directory in the CalVal Portal with free access to selected data
  - Define the corresponding reference MTF result for each test image as the mean (with outlier rejection) of the submitted estimates when actual model is not available
  - Ask users to submit their « blind test results » before accessing the reference results in order to improve the reference MTF dataset

# Actions

1. Create first Geospatial Reference Data Set
  1. Use 6 'High Priority Data' test images
  2. Forward to IVOS Chair for transmittal to WGCV
2. Write Journal Paper on MTF estimation methods and results generated thus to serve as reference for broader community
3. Finalize Comprehensive Test Site Catalog
  1. Add KARI site in Mongolia
  2. Add Australia line target used by Digital Globe
  3. Forward to IVOS Chair for transmittal to WGCV

# Foreseen Additional Tasks

(when we get further down the road)

- Generate more comprehensive suite of simulated and actual test images
- Address figures of merit (FWHM, Edge Slope, RER, etc)
- Address sensitivity, precision and accuracy, traceability(?)
- Begin looking at bridge targets