STATISTICAL CALIBRATION and DESTRIPING
MCST (MARCH 2005)

THE ASSUMPTION

ALL DETECTORS SAMPLE THE SAME DISTRIBUTION OF
ILLUMINATION CONDITIONS AND
SURFACE REFLECTANCESE
OR
SURFACE TEMPERATURES AND EMISSIVITIES

PERFECTLY CALIBRATED DETECTOR RADIANCES MUST HAVE SAME STATISTICS (MEANS, VARIANCES, ETC.)

THE DEVIATIONS IN THE STATISTICS OF A DETECTOR FROM "TRUTH" IS A MEASURE OF CALIBRATION ERROR

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THE RELATIONSHIPS

$$S_k = F_k(\mathbf{X}); \quad \mathbf{X} = G(\mathbf{O}, \mathbf{C})$$

Error **dC** in calibration **C** leads to deviation **dS** in **S**

$$\mathbf{dS = H\ dC}$$

$$H_k = (dS_k/dC_i), \quad (k=1,ns;\ i=1,nc)$$

For ns .GE. nc, the optimal solution is diagonal elements

! $$\mathbf{dC} = (\mathbf{H^T W H})^{-1} (\mathbf{H^T W dS})$$

! $$\text{Variance}(\mathbf{dC}) = (\mathbf{H^T W H})^{-1} \text{ diagonal elements}$$

! $$Wkk' = 1/\text{Variance}(Sk) \text{ for } k=k'$$

$$= 0 \text{ for k not equal to } k'$$

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PRACTICAL CONSIDERATIONS

Implicit Assumption: Stable calibration
Domain of Validity of Fitted calibration (local)
Selection of Calibration Equation (# of Parameters)
- Statistical “Degrees of Freedom” imbedded in the scene
- The Quality of Fit
- Favor minimum parameter solution

Full Dynamic Range Calibration (Scene Selection)
- “Degrees of Freedom”
- Dynamic Range Considerations
- Composite Scenes

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DESCRIPTION OF TESTING PROCEDURE

Starting Point

- Input Scene
- Scaling to raw data quantization
- Input calibration parameters
- Selection of “truth” detector”
- Selection of number of statistics to use
- Both linear and non-linear fitting

Comparison of Before-Aft statistics of a representative detector

Application of new calibration (linear case only)

- Rescaling
- Before and after scene comparisons

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Next Steps

Publish the basic algorithm

Develop Criteria for “truth” selection

Test cal stability assumption using varying length segments

Develop/Select “scenes” for full dynamic range calibration

Develop criteria to identify the need for nonlinear fit

Apply to the actual raw data and initial cal as input

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