"Destriping Algorithm for improved..."

Methodology

- not using static values for thresholds for destriping pixels in new method.
  - recalculated and adjusted for each data granule based on the info in the gradient data itself.
- Striping is large in high sun glint areas. → pixels in these areas are disregarded when deriving the values of thresholds of derivatives
  - these areas still have the potential to fall into the destriping domain and be successfully destriped.

☆ Histogram: shows gradients both along-scan and across-scan directions

Threshold value calcs:

$D = \min[\alpha D_{0.99}, D_{max}]$

☆ $D_{0.99}$ = 99th percentile of distribution of abs values of gradients

- meaning $D_{0.99}$ > abs values of 99% of pixels in the destriping domain.

☆ Mask(x,y)

applying iterative procedure

$$M(x,y) = \begin{cases} 1, & |f(x+1,y) - f(x,y)| > D_x \cup |f(x,y+1) - f(x,y)| > D_y \cup (x,y) \in (\text{land, ice, clouds}), \\ 0, & \text{otherwise.} \end{cases}$$

☆ D_x = along the scan threshold vals

☆ D_y = across the scan threshold vals

☆ $f(x,y)$ = original image.

★$M(x, y=0)$ = subject to striping
★$M(x, y=1)$ = preserved without changes.

- want to avoid using cross-scan gradient because they are strongly affected by striping artifacts.

★Laplacian based on restricted gradients:

$$L(x,y) = f(x-1,y) - 2f(x,y) + f(x+1,y) + M(x,y)[f(x,y+1) - f(x,y)] + M(x,y-1)[f(x,y-1) - f(x,y)]$$

$$L(x,y) = u(x-1,y) + u(x+1,y) + u(x,y-1) + u(x,y+1) - 4u(x,y)$$

★$u(x,y)$ references reconstructed image.

★need to solve a system of equations for $u(x,y)$
- simplified by transforming to the Fourier space (k_x, k_y) where the linear equations decouple into simple algebraic eqs for diff. Fourier components

$$L(k_x, k_y) = [2\cos(\pi k_x / N_x) + 2\cos(\pi k_y / N_y) - 4]\, u(k_x, k_y)$$

remove artifacts from striped image component - using nonlinear Gaussian type filter:

$$p(x,y) = \sum_{z=y-H/2}^{z=y+H/2} r(x,z) \exp\left\{-\frac{[r(x,y)-r(x,z)]^2}{2\sigma^2}\right\} \Bigg/ \sum_{z=y-H/2}^{z=y+H/2} \exp\left\{-\frac{[r(x,y)-r(x,z)]^2}{2\sigma^2}\right\}$$

☆ H = filter size
☆ y = y coordinate
☆ $r(x,y)$ = striped component of the image.
☆ exp = exponential function.
☆ σ = band dependent nonlinear filter parameter

- there is a wide range in the magnitude of striping, so the filter parameter needs to be adjusted adaptively

- measure stand. dev. of difference $\Delta r = r(x,y) - r(x,z)$ over all pixels belonging to the destriping domain

$$\underbrace{\sigma_0^2 = \langle(\Delta r - \langle\Delta r\rangle)^2\rangle}_{\text{average taken over all differences in the destriping domain.}}$$

$$\langle\Delta r\rangle = \sum_{(x,y)\in M(x,y)=0} \left\{\sum_{z=y-H/2}^{z=y+H/2} [r(x,y)-r(x,z)]\right\} \Bigg/ \sum_{(x,y)\in M(x,y)=0} H$$

val. of filter parameter:

$$\sigma = \min[\beta\sigma_0, \sigma_{max}]$$

☆ $\beta = 0.4$ giving best improvement to image quality.