Unveiling Shadows: How to Optimize Shadow Detection in HSI through Combination of LiDAR and Histogram Thresholding

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Unveiling Shadows: How to Optimize Shadow Detection in HSI through Combination of LiDAR and Histogram Thresholding  
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Abstract
Shadows result when direct sun light is obstructed and the spectral reflectance values for the red, green and blue bands decrease, however, the blue decreases the least. There have been several attempts to find the most optimal method to correct this blue skew. Since there already exist numerous, effective shadow detection and removal algorithms, this research proposes a hybrid method tailored for regions that have access to existing Light Detection and Ranging (LiDAR) data. This research utilizes histogram thresholding proposed by Nagao (et. al 1979) on the blue band and a geometric model-based method proposed by Tolst (et. al 2011) using a digital surface model (DSM) derived from LiDAR combined with shadow modeling to further improve accuracy and provide validation.

Goals
- Examine different shadow detection methods
  - LiDAR simulation
  - Band Combination ROI
- Define shadow regions of interest
- Verify classification across approaches
- Validate shadow range

Software
- ENVI 5.5
- ArcMap Desktop 10.6.1

Data
Iowa LiDAR Mapping Project  
- GeoTree 2007
  - LAS Digital Elevation Model
  - 2-meter spatial resolution

Hyperspectral Image
- AISA 2006
  - 63 spectral bands
  - 1-meter spatial resolution
  - FLAASH Atmospheric Correction
  - Wavelength range: 401.15 – 981.68 nm

Study Area
- UNI Campus, Cedar Falls, IA

Conclusions
- Shadow detection by creating a mask based from a Region of Interest on the newly combined histogram yield better results than those performed on standalone band.
- Cannot make assumptions on the accuracy of the LiDAR simulation without the proper acquisition time and further addressing the issue with no data.
  - required for proper solar info
  - skews shadow pixel count
- Accuracy assessment was done through visual comparison and a better method should be considered.