

Distinguishing Urban Sprawl Features from Green Patches in IGI Airport Area using Custom Enhancement

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Project Overview & Goals

The goal of this project is to delineate and enhance the urban features in the areas surrounding the IGI airport in the capital city of India.

Study Area Description

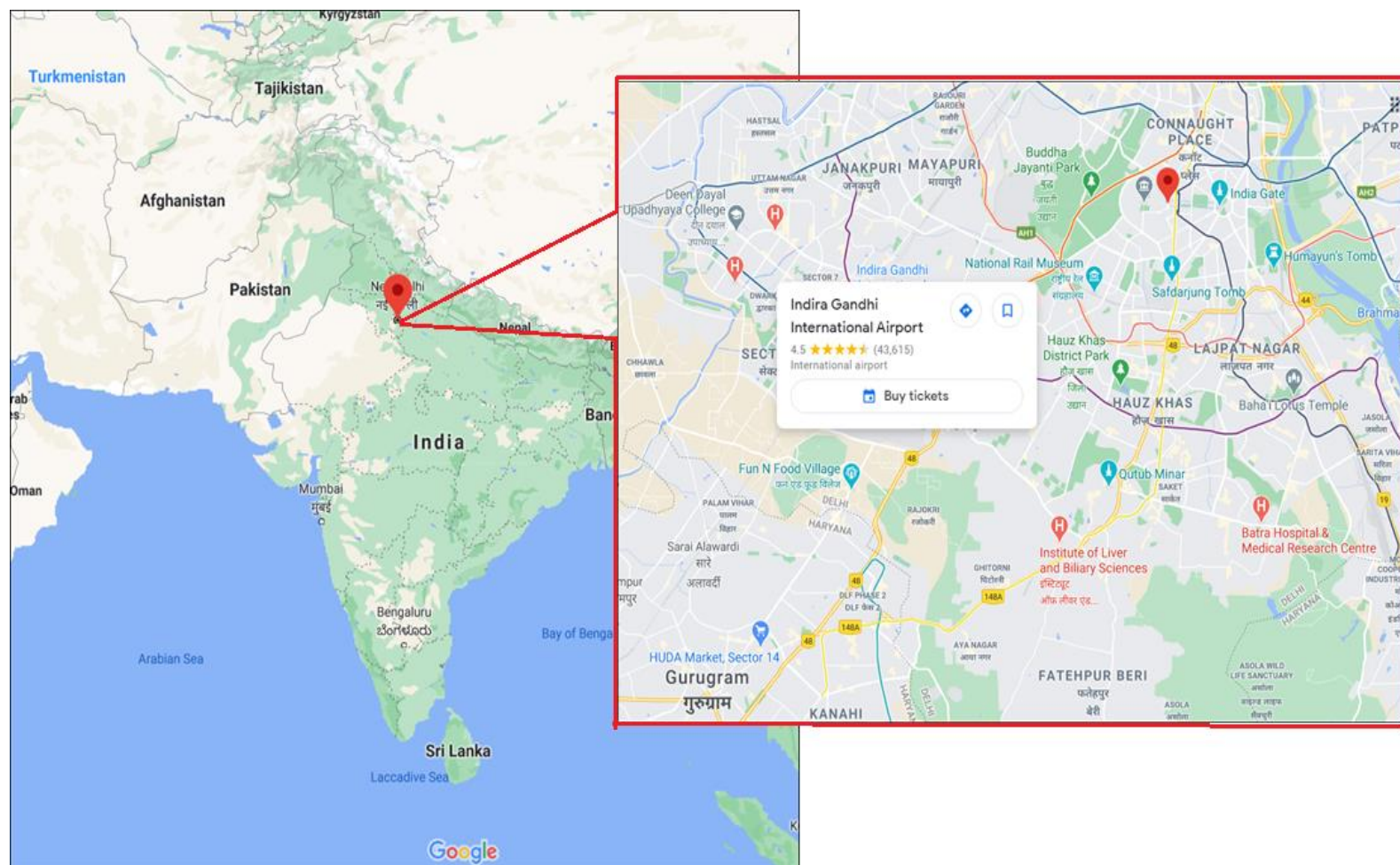


Figure 1 – Left – India, Right – New Delhi (Indira Gandhi International Airport area)

The area near IGI Airport is heavily urbanized and contains a few reserved green patches, which makes the urban features hard to distinguish. The area has a plain topography

Data Acquisition & Preparation

The data was downloaded from USGS Earth Explorer using Landsat 8 OLI Level 1 imagery then exported to PCI Geomatica and clipped to suitable area (25x26 km). Standard pre-defined Linear enhancement was applied followed by custom enhancement to highlight the urban areas using histogram stretch and limiting DN values revolving around study area.

Choice of Spectral Bands

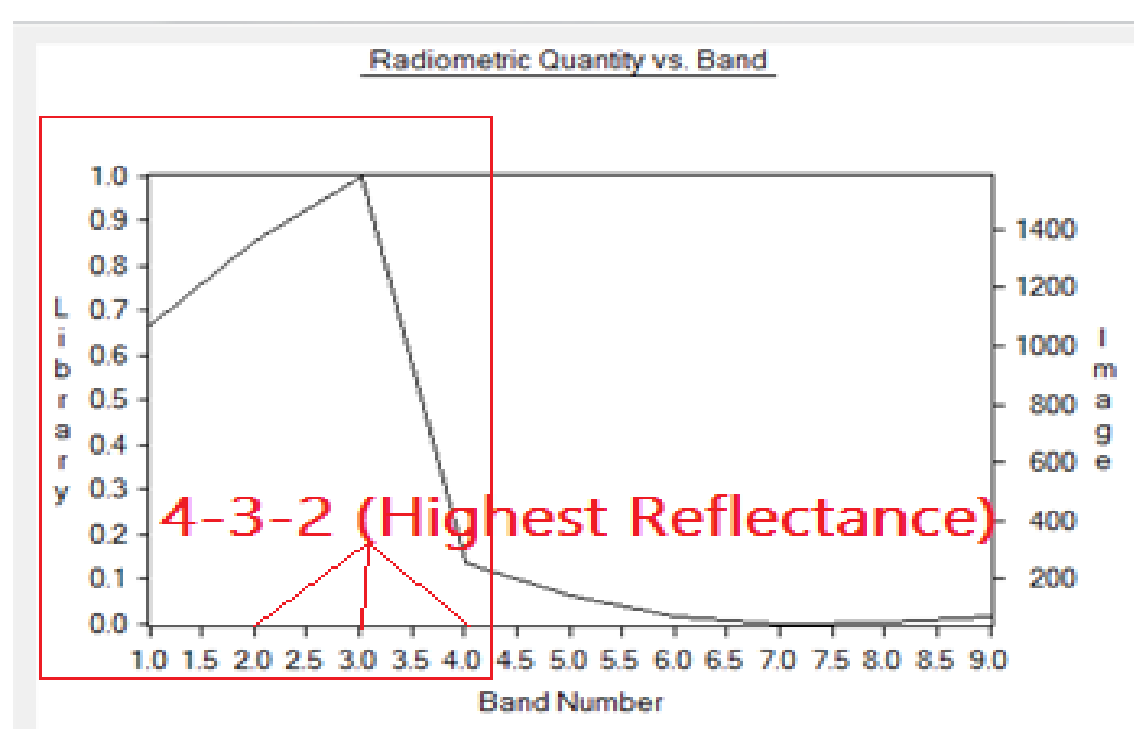


Figure 2 –Hyperspectral Spectra Plot – Urban Feature (Road)

Composite 4-3-2 was chosen out of 9 bands as a sample check shot taken of a road strip shows high reflectivity in these bands. Anthropogenic features are highly reflective in Green & Red bands. Blue band is less reflected by chlorophyll. This combination will help in 'dulling' the green patches.



Figure 3 – True Color Composite (No enhancement)



Figure 4 – Standard Enhancement (Linear)

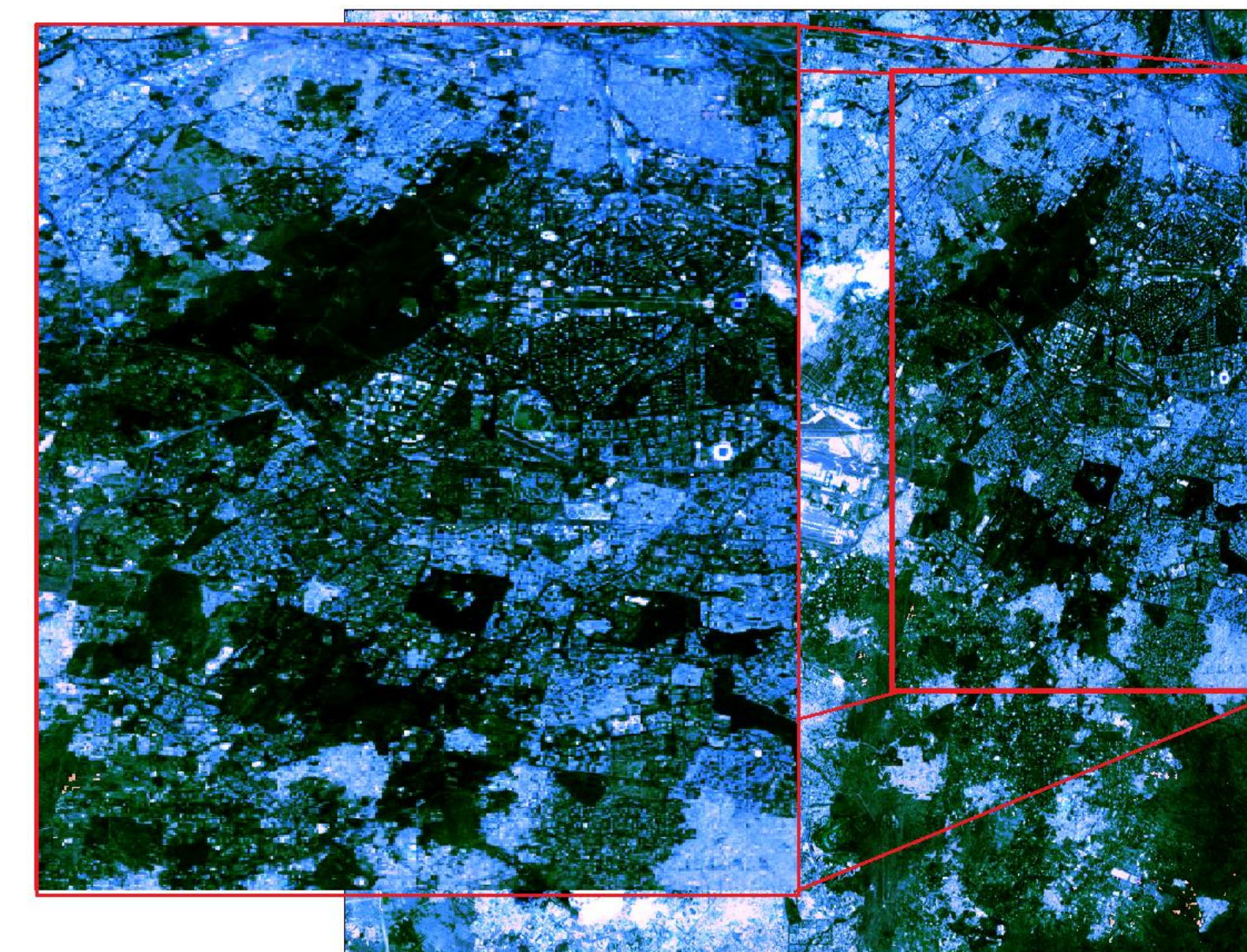


Figure 5– Custom Enhancement

Enhancement Methodology

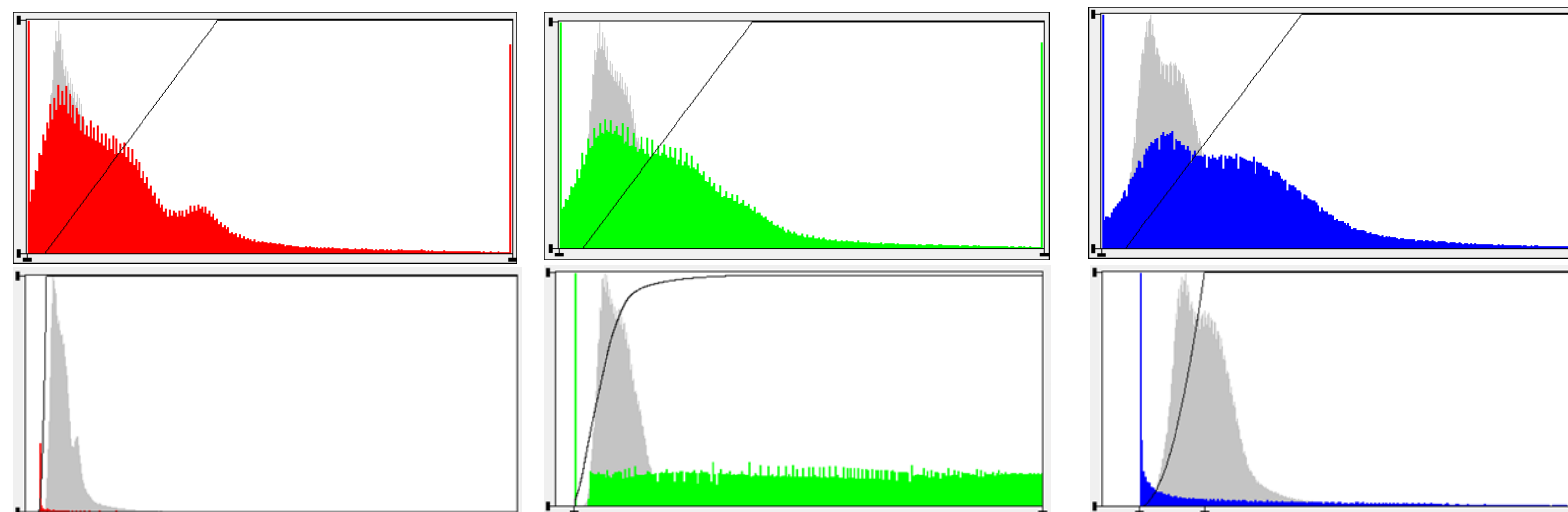


Figure 6 – Above – LUTs of Standard Enhancement (Linear), Below – LUTs of Custom Enhancement

Standard Enhancement:

Out of multiple standard enhancement tools provided in PCI Geomatica, the linear enhancement tool was used as it stretches the histogram DN values in a linear fashion normalized to a DN of 0 to 255 vis-à-vis the 12-bit radiometric DN values of Landsat 8 OLI.

As shown in Figure 6, the stretch is visible in a linear fashion across all 3 bands. Comparing Figure 4 with Figure 3 shows how linear enhancement has made the urban features visible but it is also calling for further enhancement as the objective is not yet achieved, i.e., to distinguish and enhance the urban features.

Custom Enhancement:

Upon looking at most urban features, it was observed that the DN values (12 bit radiometric) ranges from 850-950 in Blue Band (shown by Red Band), 1000-1150 in Green Band and 1300-2000 for Red Band (shown by Blue Band).

As seen in Figure 6, radiometric limits were applied in LUTs as per the above-mentioned intervals. As our feature of interest lies mostly in Red Band (shown by Blue Band) here, its intervals were stretched by square function as most values were large. After trying other functions, Green band was stretched using Equalization function and Blue Band (shown by Red Band) was stretched using square root function to stretch shorter values.

Conclusion & Imagery Discussion

As shown in Figure 3, the true color composite failed to provide any distinguishing feature except white clouds. Standard Enhancement shows somewhat fair urban features shown as dull brownish in color but strongly missing a contrast to effectively separate from green patches in urban clusters.

Custom enhanced imagery stretches the Red Band (shown by Blue Band) thus a bright blue color now effectively shows the difference between surrounding 'dull' green areas which is basically stretched using equalization function for best visual effect. Urban features are much clearer now in bright blue color and green patches are in dark green color. The study objective is achieved, however, one drawback of this custom enhancement is that the 4-3-2 bands being short-wave radiations were not effective in penetrating and 'seeing-through' the clouds.

Meta-Data and Data Sources

Imagery Source: USGS Earth Explorer
Scene ID: LC81470402020144LGN00
Acquisition Date: May 23, 2020
Path: 147, Row: 40
Projection: UTM (Zone 43)
Datum: WGS '84

Location Map Image Source:
Google Maps

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