Color Representation for Multiband Images thanks to Bayesian Classifier

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Introduction

• Goal: the display of multiband images or hyperspectral cubes
• Easy with 3 channels (Red Green Blue (RGB) look-up table) but the difficulties arise when n>3 bands.
• Main idea: the use of a segmentation map
  → factorial discriminant analysis (Fisher Analysis) for data reduction
  → Fisher eigenvectors coding in HLS (Hue Lightness Saturation) space rather than in the so-called RGB space.

HSV space

The HSV color representation (or any of its variants such as the HLS and the HSV color spaces) captures human intuitions about the experience of color:
• Hue means what is casually referred to as color (such as red, green, purple and yellow).
• Saturation indicates the colorfulness of an area in proportion to its brightness.
• Intensity (that is equivalent to Lightness in the HLS and Value in the HSV color spaces) is related to the color luminance.

The conversion equations from RGB to HSV space are:

\[
H = \cos^{-1}\left( \frac{1}{\sqrt{(R - G)^2 + (R - B)^2}} \right)
\]

\[
S = \max(R, G, B) - \min(R, G, B)
\]

\[
V = \max(R, G, B)
\]

The conversion equations from HSV space to RGB are:

\[
R = \min(C, 60 	imes C) + \frac{V}{2}
\]

\[
G = \min(C, 60 	imes C) + \frac{V}{2}
\]

\[
B = \min(C, 60 	imes C) + \frac{V}{2}
\]

Markovian segmentation

Markovian segmentation generates a label map, required to affect a spatial location (observed at different wavelengths) to a single class. The contextual prior makes each pixel labeling dependent from all others (Markovian property). This partition allows to develop a Fisher analysis maximizing the scattering between classes and compacting each cloud of labeled observations around its centroid.

Multiband representation within a single color image thanks to the label map

Multiband data and Fisher analysis

\[
T = \sum_{j=1}^{q} \frac{y_j}{2q} \sum_{i=1}^{P} (y_{ij} - \bar{y}_j)(y_{ij} - \bar{y}_j)
\]

\[
T = \sum_{j=1}^{q} \frac{1}{P} \sum_{i=1}^{P} (y_{ij} - \bar{y}_j)(y_{ij} - \bar{y}_j)
\]

\[
y_{ij} \text{ stands for the average of row } j \text{ for class } i
\]

\[
y_{j} \text{ stands for the average of row } j
\]

http://voltairemiv.u-strasbg.fr/