>>> Feature Extraction >>> GRSS Summer School

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Date: [2017-04-26 Wed 10:30]-[2017-04-26 Wed 12:00]

1. Motivations

2. Physical Indices

Introduction
Vegetation Indices
Case study

3. Statistical Feature Extraction

Unsupervised Supervised

4. Spatial feature extaction

Linear filters
Mathematical morphology

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[2/19]

2. Physical Indice

Introduction
Vegetation Indices
Case study

3. Statistical Feature Extraction

Unsupervise Supervised

4. Spatial feature extaction



* Curse of dimensionality: it is not possible to get enough data to cover all the observation space.

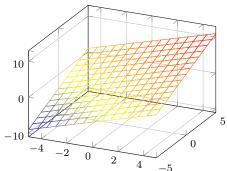
High dimensional saces are mostly empty!

[1. Motivations]\$ _ [4/19]

 \star Curse of dimensionality: it is not possible to get enough data to cover all the observation space.

High dimensional saces are mostly empty !

⋆ Multivariate data live in a lower dimensional space



>>> Application

- ★ Feature extraction is important in remote sensing because:
 - * It reduces the size of the data,
 - * It limits the spatial and spectral redundancy,
 - * It permits visualization of the data,
 - * It mitigates the curse of dimensionality.
- * Extraction techniques:
 - ⋆ Spectral
 - * Physically based method,
 - * Statistical methods.
 - * Spatial:
 - * Linear filters,
 - ⋆ Non linear techniques (Mathematical Morphology)

Motivation:

2. Physical Indices

Introduction Vegetation Indices Case study

3. Statistical Feature Extraction

Unsupervise Supervised

4. Spatial feature extaction

2. Physical Indices

Introduction

Vegetation Indices

3. Statistical Feature Extraction

Unsupervise Supervised

4. Spatial feature extaction

Linear filters

Mathematical morpholo

[2. Physical Indices]\$ _ [7/19]

- * Spectral indices are a linear/non-linear combination of two (or more) spectral bands.
- ★ They provides information as a *single number* about:
 - ⋆ Plant structure,
 - * Biochemistry,
 - ⋆ Humidity,
 - Stress.
- ★ Four main types [TLH11]:

Name	Formulae
Difference vegetation index	$\begin{array}{c} R_{\lambda_1} - R_{\lambda_2} \\ R_{\lambda_1} \end{array}$
Ration vegetation index	$\frac{R_{\lambda_1}}{R_{\lambda_2}}$
Normalized difference vegetation index	$\frac{\overline{R_{\lambda_2}}}{R_{\lambda_1} - R_{\lambda_2}}$ $\frac{R_{\lambda_1} - R_{\lambda_2}}{R_{\lambda_1} + R_{\lambda_2}}$ $(1+L) \times \frac{R_{\lambda_1} - R_{\lambda_2}}{R_{\lambda_1} - R_{\lambda_2} + L}$
Soil-adjusted vegetation index	$(1+L) \times \frac{R_{\lambda_1} - R_{\lambda_2}}{R_{\lambda_1} - R_{\lambda_2} + L}$

* The three last indexes are invariant to a multiplicative factor

Index database : http://www.indexdatabase.de/

Name	Formulae (λ nm)
Normalized Difference Vnegetation index	$rac{R_{\lambda_{800}}-R_{\lambda_{670}}}{R_{\lambda_{800}}+R_{\lambda_{670}}}$
Modified Soil-Adjusted Vegetation Index	$\frac{1}{2} \left[2R_{\lambda_{800}} + 1 - \sqrt{(2R_{\lambda_{800}} + 1)^2 - 8(R_{\lambda_{800}} - R_{\lambda_{670}})} \right]$
Modified Chlorophyll Absorption Ratio Index	$ \frac{R_{\lambda_{800}} + R_{\lambda_{670}}}{\frac{1}{2} \left[2R_{\lambda_{800}} + 1 - \sqrt{(2R_{\lambda_{800}} + 1)^2 - 8(R_{\lambda_{800}} - R_{\lambda_{670}})} \right]} \\ [(R_{\lambda_{700}} - R_{\lambda_{670}}) - 0.2(R_{\lambda_{700}} - R_{\lambda_{550}})] \times \frac{R_{\lambda_{700}}}{R_{\lambda_{670}}} $
Normalized Difference Water Index	$R_{\lambda_{858}} - R_{\lambda_{1240}}$
Datt Reflectance Index	$rac{R_{\lambda_{858}}+R_{\lambda_{1240}}}{R_{\lambda_{816}}-R_{\lambda_{2218}}} = rac{R_{\lambda_{816}}+R_{\lambda_{2218}}}{R_{\lambda_{816}}+R_{\lambda_{2218}}}$
Normalized Difference Redness Index	$\frac{R_{\lambda_{540}} - R_{\lambda_{700}}}{R_{\lambda_{540}} + R_{\lambda_{700}}}$
Soil Brightness Index	$0.406R_{\lambda 550} + 0.600R_{\lambda 650} + 0.645R_{\lambda 750} + 0.243R_{\lambda 950}$

2. Physical Indices

Introduction

Vegetation Indices

Case stud

3. Statistical Feature Extraction

Unsupervised Supervised

4. Spatial feature extaction

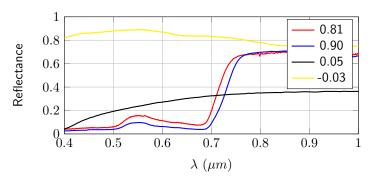
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>>> Normalized difference vegetation index

$$\text{NDVI} = \frac{R_{\lambda_{800}} - R_{\lambda_{670}}}{R_{\lambda_{800}} + R_{\lambda_{670}}}$$

- \star −1 ≤ NVDI ≤ 1
- ★ NDVI ≤ 0 : surfaces other that plant cover
- ★ NDVI ≈ 0 : bare soil
- * NDVI ≥ 0.1 : vegetation cover (higher values correspond to more dense covers)



2. Physical Indices

Vegetation Indices
Case study

3. Statistical Feature Extraction

Unsupervised Supervised

4. Spatial feature extaction

I. Motivations

2. Physical Indice

Introduction
Vegetation Indices
Case study

3. Statistical Feature Extraction

Unsupervised Supervised

4. Spatial feature extaction

1. Motivations

2. Physical Indices

Introduction
Vegetation Indices
Case study

3. Statistical Feature Extraction

Unsupervised

Supervised

4. Spatial feature extaction

1. Motivations

2. Physical Indices

Introduction
Vegetation Indices
Case study

3. Statistical Feature Extraction

Unsupervised

Supervised

4. Spatial feature extaction

L. Motivations

2. Physical Indice

Introduction
Vegetation Indices
Case study

3. Statistical Feature Extraction

Unsupervise Supervised

4. Spatial feature extaction

1. Motivations

2. Physical Indices

Introduction
Vegetation Indices
Case study

3. Statistical Feature Extraction

Unsupervised Supervised

4. Spatial feature extaction

Linear filters

Mathematical morphology

1. Motivations

2. Physical Indices

Introduction
Vegetation Indices
Case study

3. Statistical Feature Extraction

Unsupervise Supervised

4. Spatial feature extaction