Hard and soft image classifications

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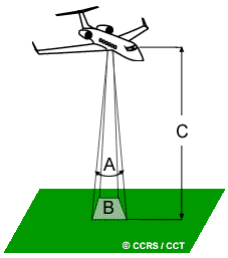
Geog 581

Pure and mixed pixels

- Dependent on
  - Heterogeneity
  - Pixel size
  - Class variance



Canada Centre for Remote sensing

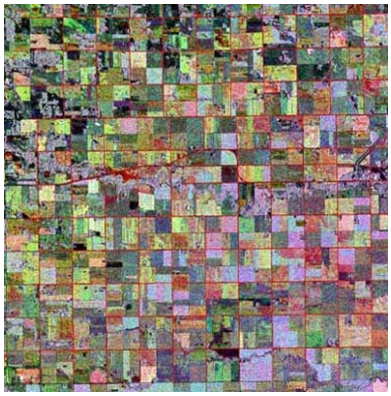
Ikonos data © Space Imaging Inc, courtesy of www.spaceimaging.com.

Hard vs. soft classifications

- Per-pixel classification methods
  - *Hard classifications* - each pixel belongs to the class it most closely resembles
  - *Soft classifications* - each pixel can belong to more than one class and has membership grades for each class

Hard classifiers

- Homogenous areas (e.g. croplands, waterbodies)
- Dependent upon spatial scale and the variance of classes
- Low classification accuracy in heterogeneous areas



Crop map developed from multi-temporal RADARSAT-1 data of Carman, Manitoba, Canada. MacDonald, Dettwiler and Associates Ltd.

Soft classifications

- Heterogeneous areas relative to spatial scale
  - e.g. residential areas, mixed forests
- Gradients
  - e.g. forest to savannah, clear to turbid water

A SeaWiFS image showing red tide conditions along the Gulf Coast of Florida and Louisiana on March 1, 1999. *Map Credit: Courtesy of the SeaWiFS Project, NASA/Goddard Space Flight Center, and ORBIMAGE*

Hard classification methods

- ISODATA (unsupervised classification)
- Parallelpiped
- Centroid (k means)
- Maximum likelihood
- Neural networks

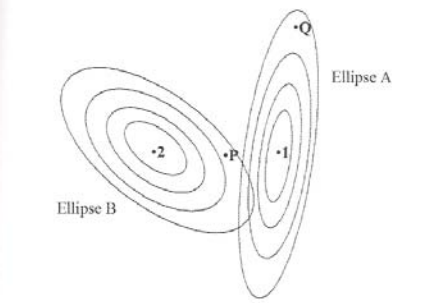
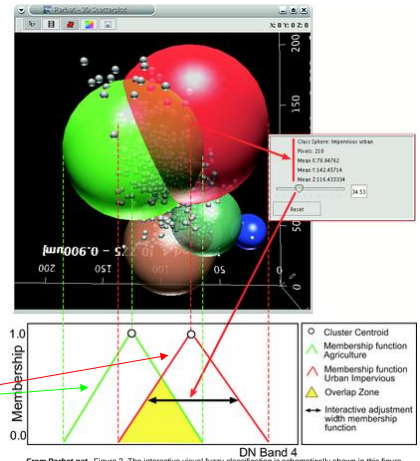


Figure 8.14 Showing the equi-probability contours for two bivariate-normal distributions with means located at points 1 and 2. Point P is closer to the mean centre of distribution 1 than it is to the centre of distribution 2 yet, because of the shapes of the two ellipses, P is more likely to be a member of class 2. Similarly, point P is closer to the centre of distribution 1 than is point Q, yet Q is more likely to be a member of class 1.

Soft classification methods

- Linear mixture modeling
- Fuzzy classification

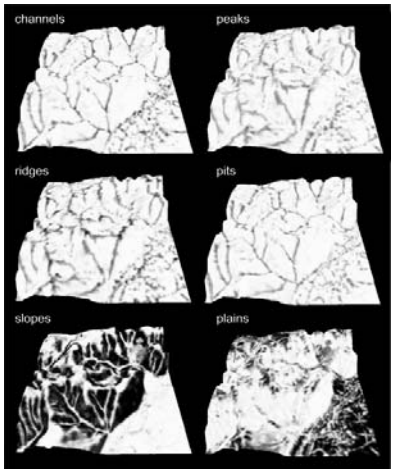
Membership functions



From Parbat.net. Figure 3. The interactive visual fuzzy classification is schematically shown in this figure. The agriculture and urban impervious overlap in the 3D feature space plot (A). The class spheres depict the triangular membership functions, which are used for classification. Membership values for unclassified pixels are calculated based on these membership functions. Figure 3B shows the membership functions of the two of the two overlapping classes projected on one bands (band 4). When selecting one of the spheres, a user is presented with a popup window including a slider. This slider is used to adjust the radius of the sphere, thereby changing the width of the membership function and possibly changing the overlap with another class/membership function.

Soft classification examples

- Determine membership grades for each class and display as brightness (classification certainty)
- Determine membership grades for three classes and apply to RGB colorguns



http://spatial-analyst.net/fuzzy.php

Defuzzification

- Produce a crisp result (one pixel to only one class) from fuzzy membership grades
  - Highest membership
  - Fuzzy centroid (center of gravity)
  - Fuzzy center of sums