Digital Image Processing

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Object recognition

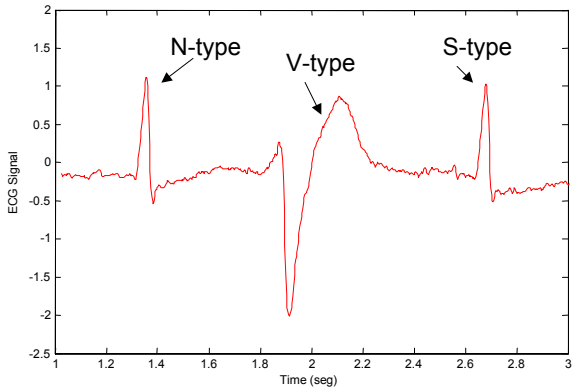
Introduction to object recognition

Object recognition often starts with
- Feature extraction
  - →Possibly followed by dimensionality reduction (PCA)
- Clustering
- Decision boundary making

In some applications this process is “semi-blind” and in others it is based on template matching. In template matching applications a crucial part is definition of degradation invariant features.

Some object recognition techniques are based on simple concepts while others employ complex systems such as neural networks. Object recognition based on these complex systems is out of the scope of this course

1D example: recognition of ECG peaks



In this aplication, problem is to discriminate between normal types of peaks (N-peaks) and two types of abnormal peaks (S-peaks) and (V-peaks)

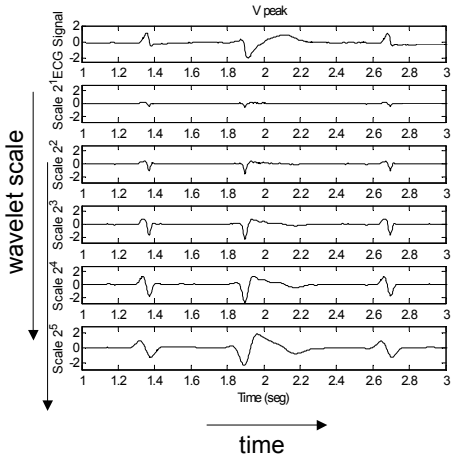
Application: intelligent pacemakers

…1D example: recognition of ECG peaks

For feature extraction, in this example non-decimated wavelet transform is used with quadratic spline wavelet

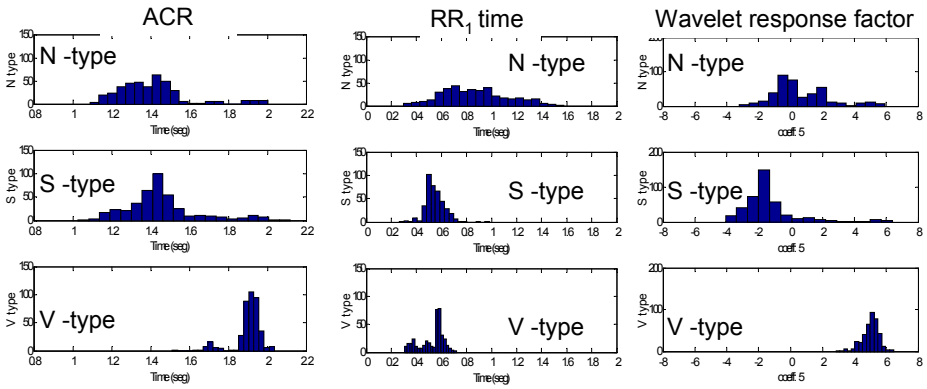
Examined features

- Modulus maxima at different scales
- Average Cone Ratio (ACR)
- Coefficient energy within the cone of influence
- A wavelet response shape factor
- A time domain feature (time to previous peak – so called RR_1time)



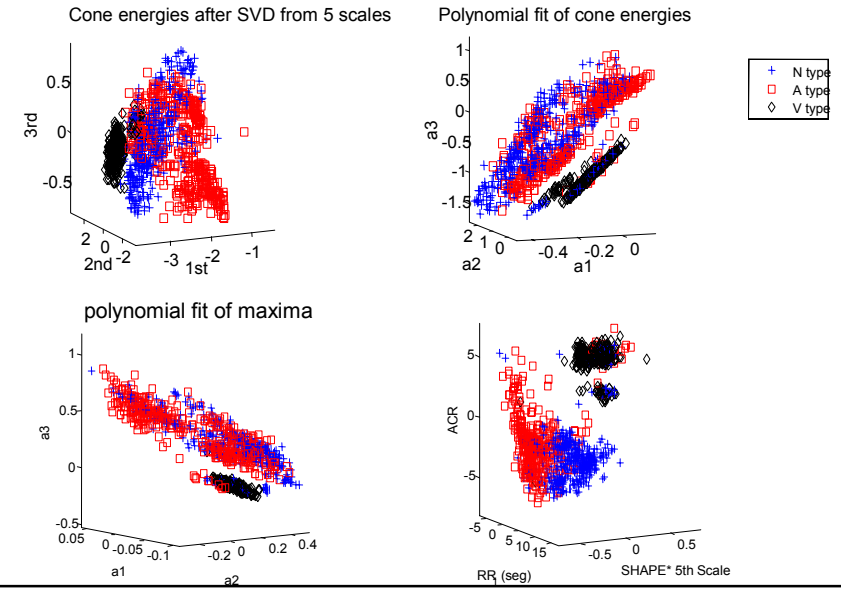
…1D example: recognition of ECG peaks…

Example of feature distributions



…1D example: recognition of ECG peak

Feature clustering



Classification

Classification can be made based on the distance of the pattern under study and the centroids of each cluster

Different distance measures can be defined:

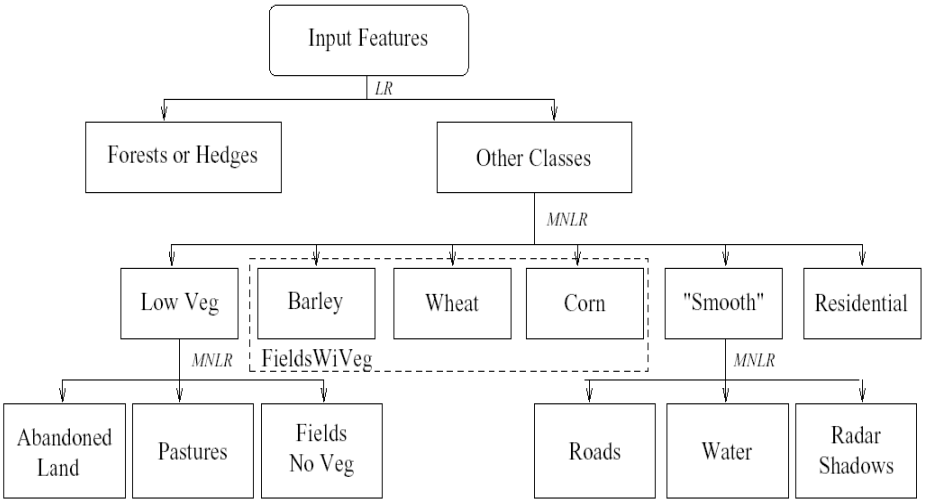
- Euclidian distance
- Mahalanobis distance (takes int account the covariances of different clusters)

Some of the well-known classifiers

- K-means clustering
- Fuzzy C-means clustering
- Bayesian classifiers

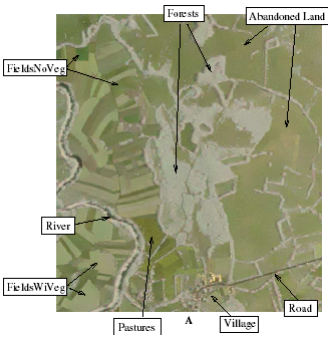
Bayesian classifiers often model data clusters by multivariate Gaussians (for simplicity reasons)

Hierarchical classification

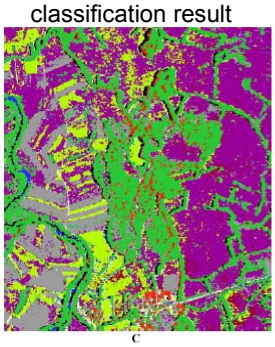


Classification example

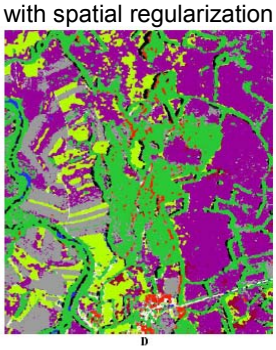
speckle-reduced polarimetric SAR mage



classification result



with spatial regularization



C1 C2 C3–5 C6 C7 C8 C9 C10 C11

different classes of the terrain