INF5300 – Spring 2015 | Mandatory exercise

This exercise consists of three parts. All must be addressed.

Deadline: April 27, 2015.
Submission: Your report must be submitted as a single PDF file containing the problem description, discussion, and the supporting source code. Submit your report by email to arej@ifi.uio.no and anne@ifi.uio.no with subject title "INF 5300/9300".

The report should contain a description of the problem, theory, chosen methods, results and algorithms used.

Part I: ***A comparison of PCA and Fisher's reduced-rank linear transform for classification of hyperspectral image data***

Use as input the Pavia image data[*]. Implement PCA and Fisher's reduced-rank linear feature transform using built-in Matlab functionality like eig(). Use the transformed features as input to both linear and quadratic Gaussian-based classifiers. You can use PRTools [**] for the classification part (ldc/qdc). Compare classification results (e.g. classification error-rates) for varying dimensionality.

[*] The image was taken on June 8th, 2002, and is of a scene over Pavia, Italy. The flight was flown in the framework of the HySens project, managed by Deutschen Zentrum fur Luft- und Raumfahrt (DLR).

To load the data: load /projects/asbjorb/datasets_post20070209/pavia_dataset.mat

To get the raw data samples you can use e.g. dataTrain = pavia_trainset.data; To get the label of each sample, if you have PRTools installed: getlab(pavia_trainset); Else, use pavia_testset.nlab;

Name of class-labels:
C1 water
C2 trees
C3 meadow
C4 soil
C5 asphalt
C6 parking lot
C7 roofs
C8 bitumen
C9 shadow

Remember to include in the report a quick summary of PCA and Fisher's reduced-rank linear feature transform, as well as (at least part of) your Matlab implementations.

If you have time, feel free to study 2D scatterplots, confusion matrices, visualization of the feature transform weights, etc.

[**] The PRTools package is downloadable from http://www.37steps.com/software/ You might want to have a look at the script on "curse of dimensionality" on the course page if you are unfamiliar with PRTools.

Part II: ***Classifying hyperspectral image data using SVM with a RBF kernel***

Use the same data as in part I. Use all features (no linear or nonlinear feature reduction schemes). User data from classes C4 and C5 only. Build a SVM classifier using a RBF kernel. Use 10-fold crossvalidation to set the user-parameters; C and σ. Explain the rationale behind this. Report on the final error-rate of the classifier.

Part III: ***Segmentation using snakes***

Your task is to use a snake to perform a segmentation of the image ~inf5300/www_docs/data/seismic_timeslice.mat. An indication of which boundary we are looking for is given as the red curve on foil 12 on the lab exercise on segmentation. We are looking for the boundary of a salt structure, and the boundary is on the border between the more homogeneous inside and the dark/bright structures surrounding it.

1. First you must find a suitable feature to use for segmentation. Remember that the snake algorithm will look for a minimum in the feature image, so your feature image should have a minimum (possibly local) at the boundary. Discuss shortly what kind of feature you could use. If the feature gives a homogeneous region for the structure inside the boundary, you might have to compute the derivative of the feature and use this derivative as the snake feature image.
2. Implement ONE such feature and show the resulting feature image. Find a good window size for your feature.
   Hint: a simple feature based on variance in a certain window size might be a simple solution.
   PHD Students only: *you must implement a suitable texture feature and cannot use variance as a feature.*
3. Find a way to initialize the snake.
4. Perform a segmentation using the regular snake and discuss how it works.
5. Try the gradient vector flow field as input to the snake and compare the performance.
6. Discuss your results and their sensitivity to snake parameters GIVEN your selected feature input image.