Computer exercise 5
Image segmentation using Gaussian mixture models
Statistical image analysis, TMS016

1 Introduction

The purpose of this computer exercise is to give an introduction to image segmentation using Gaussian mixture models. Before you begin, download the Matlab files for the exercise from the course homepage. When in doubt about how to use a specific function in Matlab, use `help` and `doc` to get more information.

2 Segmentation of satellite data

Throughout the exercise, we will use a satellite image of Gothenburg as an example, which you can download from the course homepage.

- Use the K-means algorithm to classify the image with different number of classes K and plot the results. Can you get one class that only contains the water with this method? An implementation of the K-means algorithm is given in the function `normmix_kmeans`.
- Choose some value of K (such as 3) and use `normmix_sgd` to estimate a general Gaussian mixture model to the data. Then use `normmix_classify` to classify the image and plot the results.
- `normmix_classify` classifies the pixels by choosing the class with the highest probability for each pixel. The function also returns the actual class probabilities as a second output. To investigate the uncertainty of the classification, use the function `classification2rgb`, which you wrote in the first exercise, to plot the probabilites.
- Compare the results to the K-means classification, and in particular look at the estimated parameters of the mixture model and compare with those estimated by the K-means algorithm.

3 Plotting a segmented image

- Choose your favourite classification from above and plot the parts of the image as segmented by the method. As an example, for $K = 4$, you can plot the different parts using

```
I = imread('gothenburg_satellite.png');
I = double(I)/255;
Istack = reshape(I,[size(I,1)*size(I,2) size(I,3)]);
figure(1)
for k=1:4
  I_class = Istack;
  I_class(cl~=k,:)=256;
  subplot(2,2,k)
  imagesc(reshape(I_class,[size(I,1) size(I,2) 3]));axis image;
end
```

  where `cl` is the classification obtained from `normmix_classify` or `normmix_kmeans`.

4 Segmentation using relative colors

An often undesired feature of classifying the image using the RGB colors is that shadows can affect the results.

- Transform the image to relative colors (as in exercise 1), or to LAB colors using `rgb2lab`, and classify the image using K-means. Compare with the classification using RGB colors.
- Perform the classification using the general Gaussian mixture model can compare with the classification using RGB colors.
- Which method, which color space, and which value of K, would you say works best for this image?