Computer exercise 5
Image segmentation using Gaussian mixture models
Spatial Statistics and Image Analysis, TMS016

1 Introduction

The purpose of this computer exercise is to give an introduction to image segmentation using Gaussian mixture models. 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 probabilities. Depending on how you wrote the function, you might have to update it to allow for plotting of probabilities.
- 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?