INF 4300 – Exercises in linear transforms

This lab will use matlab to implement and explore linear feature transforms for feature extraction for images.

PCA:

1. First we work with a 6-band satellite image from Kjeller. Load the file tm.mat
2. Put all the image data into a long pattern vector nx6-matrix (one row per pixel with 6 feature values).
3. Compute the covariance matrix of the data vector.
4. Use eig() to find the eigenvectors and eigenvalues of the covariance matrix.
5. Form the A matrix by letting each column be an eigenvector of the covariance matrix.
6. Form the 6 principal components of the pattern vector using pca1(i)=x(i)*a(i).
7. Convert the 6 pricipal component nx6-vectors back to the 2D image geometry yielding 6 bands of the image.
8. Display the principal component images. Looking at them, how many do you think are useful for classification?
9. Plot the eigenvalues scaled by the sum of all eigenvalues.

Fisher's linear discriminant:

1. Read the training mask 'tm_train_mask.msk' and the feature vectors 'tm.mat'.
2. Compute the mean vectors and covariance matrices for each of the 4 classes.
3. Compute the between class scatter matrix SB.
4. Compute the within-class scatter matrix SW.
5. Compute the criterion function $J= SW^{-1}SB$
6. Do eigenvector decomposition of J
7. What is the rank of SB? How many Fisher components can you get?
8. Form the Fisher components for each pixel in the image and display them.

Classification

Try doing a classification with the same number of original bands, PCA-bands and Fisher bands? Which method yields the best classification accuracy (on the training set) using 2 features? What is the accuracy using all Fisher bands vs. all the original bands?

Implement this yourself.