

1. Image and data analysis basics

Exercises

1. For images from folder *Set 05/Textures* calculate the following statistics (use *Plugins–Analyze–Batch Measure*): min, max and mean grayscale values, standard deviation, skewness and kurtosis. Do not forget to add filenames to the table (use option *Display Label* in *Set Measurements*). Save the resulted table as *Textures.txt*.
2. Run *Evince*. Make a new project with file *Textures.txt*. Make 5-6 2D scatter plots of original data with different variables (for example min vs. standard deviation, kurtosis vs. skewness, etc.). Find one where the samples are separated very well.
3. Make PCA model with 3 principal components and show scores and loadings plots for the first two components. Compare the plots. Are there any groupings? Which variables are correlated? Which variables are negatively correlated? Which variables allow to separate different textures? Look also at the same plots but with first and third components.
4. Install *GLCM texture* plug-in for *ImageJ*. Calculate all GLCM features (use default settings) for the same textures (to do this open all images and move them to stack) save table with results and make PCA analysis in *Evince*. Do GLCM textural features discriminate textures better? Which features do the main job?

2. Multivariate image analysis

Exercises

1. Create a new Evince project with image *Bloodsmear.jpg* from folder *Set 01*. Make a PCA model for the image with 3 principal components. What do you think about having four or five principal components in this model? Analyze the scores plots (t1 vs. t2 and t1 vs. t3) and original image together. Find and explain all groupings on the scores plots. Make a PCA model without background pixels? Compare it with the first model and explain differences.
2. Create grayscale images using scores values for each principal component. Try to explain what properties of the image explained by corresponding components. Make a pseudocolor image using only first two components and comment it.
3. Create a new project with image *Hyperspectral/cereals/musli0630-1321.raw* and make a PCA model. Let the program choose the needed number of principal components. How many were chosen and why? Describe scores image and scores plot for first two components. Are there any outliers there? Delete all background pixels and rebuild the model. Analyze scores plots (t1 vs. t2, t1 vs. t3, t1 vs. t4) and original image together, find and describe all groupings.
4. Exclude nuts pixels and rebuild the model. How many components were chosen now? Analyze and describe groupings on the scores plot for first two components.

3. Classification of hyperspectral images

Exercises

1. Make a new project with image *Hyperspectral/tablets/20070098_081106-090010.raw*. Make a PCA model for the image and describe it in details (scores plots, groupings, scores images, etc) as in previous exercise. Exclude all unnecessary pixels – background, plastic, etc, rebuild and describe the new model. How many different tablets are there? Try to compare spectra of the tablets. Are they significantly different? What about spectra from the different parts of the same tablet?
2. Select one of the big round tablets, create a class *T1* and make SIMCA model. Apply the model to the whole image and describe the result. Do the same but with other type of tablet.
3. Make a new project with image *Hyperspectral/nuts/nuts_train.raw*. Do the same as for tablets – make a PCA model, exclude unnecessary pixels, etc. Make a class and SIMCA model for one of the nut. Apply this model to image *nuts_test.raw* from the same folder and explain the result.