HYPERSPECTRAL AND MULTICHANNEL IMAGE ANALYSIS

LPhD190

Copenhagen, September 8th – 19th, 2014

Main responsible: José Manuel Amigo

Course abstract

The PhD course is designed to be an introduction to hyperspectral and multichannel images and their analysis in MATLAB environment. During the course, the students will learn how to extract the relevant information from their images as well as the fundamentals of the main multivariate analysis methods (chemometrics) applied. The course will be conducted by using in-house functions programmed in MATLAB. See the following link for further information

(http://www.models.life.ku.dk/HYPERTools)

Information

- For questions, please send an e-mail to José Manuel Amigo (jmar@life.ku.dk)
- For enrolment, please send an e-mail to Jeanette Venla Hansen (jvh@food.ku.dk) or José Manuel Amigo (jmar@food.ku.dk)

Credits

7 ECTS credits

Restrictions

Maximum 15 participants. Basic knowledge and experience with the MATLAB software. A PhD course in basic MATLAB programming and analysis is held one week before this course. Please contact José Manuel Amigo Rubio (jmar@life.ku.dk) for more information on this course.

Course Coordinator

Associate professor Dr. José Manual Amigo Rubio, CU-FOOD

(http://www.models.life.ku.dk/jmar)

Course content

1. Introduction
    1.1. Types of images
    1.2. General terminology
    1.3. Outline of this course

2. Basic screening of images
    2.1. Regions of interest
    2.2. The multivariate approach

3. Pre-processing of images
    3.1. Spatial pre-processing
        3.1.1. Background removal
        3.1.2. Spatial spikes. Dead pixels. Wavelets. Interpolation
    3.2. Spectral pre-processing
        3.2.1. Dead wavelengths. Wavelets. Interpolation
        3.2.2. Spectral artefacts: De-noising, baseline removal, derivatives
    3.3. Image compression
        3.3.1. Wavelets
        3.3.2. Multivariate compression
        3.3.3. Spatial binning

4. Exploration of images
    4.1. Principal Component Analysis. The MIA approach
    4.2. Evolving factor analysis on images

5. Resolution of images. Multivariate Curve Resolution
    5.1. MCR on images.
    5.2. Constraints
    5.3. Interpretation of results.
    5.4. Augmented MCR

6. Regression models on images
    6.1. Multivariate regression models
    6.2. Validation of regression models on images

7. Segmentation
    7.1. Definition of segmentation and differences with classification
    7.2. Thresholding
    7.3. Classification methods
        7.3.1. Cluster analysis. Fuzzy clustering and K-means
        7.3.2. PLS-DA

8. Topography
    8.1. Features extraction from images. Area, diameter, excentricity, etc.
    8.2. Domain statistics. Histograms
    8.3. Fractals on images
    8.4. The concept of homogeneity. Co-occurrence matrices

Course Fee

- There is no course fee for any participant.
- There is a fee of 1000 DKR for not attending when enrolled.

Learning outcome

After the course the students will be able to apply basic multivariate data analysis to their own hyperspectral images using MATLAB as preferred platform. The course will focus on hyperspectral and multichannel images and their interpretation and analysis with multivariate methods (PCA, MCR, PLS, PLS_DA, etc). The methods treated will explicitly or implicitly cover the following application areas: classification, calibration, prediction, spectral resolution and interpretability of solutions.

Material

The material for the course (slides, tutorials, datasets, etc) will be given at the beginning of the course-block. There is no need for previous knowledge/experience in programming.

- You must bring your own laptop.

- MATLAB: You should install MATLAB on your computer. It is not mandatory to have installed the last version of MATLAB.

NOTE: If you do not have MATLAB or a laptop, please communicate with us (jmar@life.ku.dk) as soon as possible.

Datasets

During the course, the students will be given several datasets to work with. If any of the students have their own dataset, they are welcome to bring it to work on it during the course.