**Technische Universität Berlin**

Examination:

# Optical Remote Sensing

Computer Vision &
Remote Sensing

Prof. Olaf Hellwich

**Name:** . . . . . . . . . . . . . . . . . . . . . . . . . .     **Matr.-Nr.:** . . . . . . . . . . . . . . . . . . . . . . .

**Duration:** 2 hours     **Auxiliary Material:** No

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## 1 Data Analysis (25P)

You are working with data of a 3-channel multi-spectral scanner with a spatial resolution of 100 m. Your (simplified) image has 8 pixels with the following grey values

| Pixel number | Channel 1 (Green) | Channel 2 (red) | Channel 3 (NIR) |
|---|---|---|---|
| 1 | 185 | 40 | 200 |
| 2 | 170 | 20 | 220 |
| 3 | 40 | 30 | 20 |
| 4 | 90 | 160 | 110 |
| 5 | 110 | 150 | 120 |
| 6 | 180 | 20 | 200 |
| 7 | 60 | 170 | 100 |
| 8 | 188 | 40 | 220 |

a) Draw a graph (with all necessary information) showing the feature space of channel 2 and 3 and transfer all the pixels into this feature space. **(3p)**

b) With the expert knowledge that there are only **two**(!) different classes in your scene, identify possible cluster centers and mark them **CLEARLY** in the figure of the feature space. **(2p)**

c) *Data classification*:
   i. Based on your cluster centers, construct (roughly) the decision surface of the minimum distance criterion and add it to your figure. **(2p)**
   ii. Give a pixel-to-class association. **(1p)**

d) *Classification accuracy*:
   i. Is the classification of pixel #3 reasonable (Give a detailed answer)? **(2p)**
   ii. What do you propose to improve the classification result (or to make it more consistent)? **(4p)**

e) *Result interpretation*: Your final goal is to detect vegetated areas. Unfortunately, you do not have any ground truth or reference data.
   i. Which index can we use to achieve the goal? (Give the full name, not only the acronym). **(1p)**
   ii. - How is this index calculated? **(1p)**
       - What is exposed by this index? **(2p)**
       - Why? **(2p)**
   iii. Propose a simple approach to achieve your goal (including some numerical calculation illustrating your proposal). **(5p)**

# 2   General Questions (25P)

a) *Applications of Remote Sensing*: It is your responsibility to develop a sensor that can be used in the following applications:
   - Find a thief which is presumably hiding in a forest difficult to access
   - Detect a bus full of tourists stuck in the Libyan desert with an engine failure. The color of the bus is very similar to the one of the surrounding sand.
   i. Explain which sensor is well suited for such application. **(2p)**
   ii. Why (Give a detailed answer)? **(3p)**

b) *Sensor design*:
   i. How is an opto-electric scanner constructed (use a sketch)? **(2p)**
   ii. How could we acquire the bands of a multi-spectral image simultaneously? **(2p)**
   iii. What are the different resolutions that characterize a sensor (give a name and a detailed description for each resolution)? **(6p)**

c) *Image enhancement*:
   i. Explain the aim of histogram matching. **(1p)**
   ii. Describe step-by-step how it works. **(3p)**

d) *Classification*:
   i. Describe step-by-step how the unsupervised K-Means technique is working. **(4p)**
   ii. What do you have to do as a user? **(2p)**

Altogether **50 points** can be obtained. A short and accurate style should be intended.

**Pay attention to write a clear and comprehensible text. Always justify your answers!**

**Lot's of luck and do your best!**