



Examination

Computer Vision &  
Remote Sensing

# Microwave and Radar Remote Sensing

Prof. Olaf Hellwich

Name: .....

Matr.-Nr.: .....

Duration: 2 hours

Auxiliary Material: NO

*To avoid misunderstanding, you are requested to write your answers in English.*

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## 1. SAR

**(30 P)**

- i. A **SLAR** system possesses a rather low azimuth resolution. **(5 P)**
  - i. Which system parameters are defining the azimuth resolution? 3p
  - ii. Why it is not possible to increase the resolution of such system by using shorter wavelength microwaves (e. g. in the submillimeter range)? 2p
- i. Nowadays, radar imagery is very popular. **(6 P)**
  - i. List advantages for the use of radar images compared to optical imagery (at least 4). 3p
  - ii. What are disadvantages? (at least 3) 3p
- i. Each pixel of a SAR image is composed by a complex number. **(6 P)**
  - i. What is defining the amplitude? (give a detailed answer) 2p
  - ii. What are the components of the phase? (give a detailed answer) 4p
- i. A **SAR** system possesses a high resolution in both range and azimuth. **(6 P)**
  - i. Which system parameters are defining the azimuth resolution? 1p
  - ii. Which system parameters are defining the range resolution? 1p
  - iii. Explain, in a **descriptive and intuitively** appealing fashion, why both resolutions are not dependent on the sensor's altitude. 4p
- i. There are several SAR satellites currently in operation. **(4 P)**
  - i. At which bands are **current** SAR satellites operating? 2p
  - ii. Give one example of current SAR satellite capable of high resolution (name, band of operation, corresponding wavelength, approx. resolution). 1p
  - iii. Give one example of current SAR satellite capable of fully polarimetric data acquisition in an operational mode (name, band of operation, corresponding wavelength). 1p
- i. Give **two** applications that involve single channel SAR images. (Give a detailed answer). **(3 P)**

## 2. SAR Interferometry

(20)

- i. *Explain briefly all processing steps that need to be performed in order to obtain a digital surface model by means of SAR interferometry.* (5 P)
- i. In absence of deformation, an interferometric phase is mainly composed by two components. (4 P)
  - i. *What are they?* 2p
  - ii. *On which system parameters (SAR and interferometer) are they dependent?* 2p
- i. The interferometric coherence is a measure of the “phase quality” (4 P)
  - i. *How the interferometric coherence is calculated?* 2p
  - ii. *Denote 2 effects that cause a reduced coherence.* 2p
- i. Generally speaking, a deformation pattern has to be described by 3D displacement vectors at each pixel of the image. (3 P)
  - i. *Which component of this vector is measured by DInSAR?* 2p
  - ii. *Why?* 1p
- i. You want to analyze a slow surface deformation with DInSAR. *Propose a simple way to measure and analyze this deformation.* (4 P)

## 3. SAR Polarimetry

(10 P)

- i. SAR polarimetry measures 4 channels instead of only 1. (4 P)
  - i. *How the sensor is measuring these channels? (give an explanation)* 3p
  - ii. *What is additionally needed as sensor hardware?* 1p
- i. You’ve performed a polarimetric SAR image classification and you want to interpret your results. (6 P)
  - i. *Give the name of the **two** main polarimetric parameters that could be useful.* 2p
  - ii. *Which information could we obtain from these two parameters?* 4p

**60 Points** are available in total.

**A short and accurate style as well as a clear handwriting should be intended.**

**Try to make your answers clear and concise, and answer the questions that you find easiest first.**

**Good Luck!**