Technische Universität Berlin

Computer Vision &
Remote Sensing

Prof. Olaf Hellwich

Examination

Microwave and Radar Remote Sensing

Name: …….. **Matr.-Nr.**:……..

Duration: 2 hours **Auxiliary Material**: NO

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

Berlin, 20th July 2015

1. SAR	**(30 P)**
a. Describe the imaging geometry of a SLAR/SAR system (using a sketch). Take care to include all useful information, mainly all variables of interest (e.g. range and azimuth direction, …).	**(5 P)**
b. A SLAR/SAR system uses a slant range geometry: **1.** Explain why it is necessary to use a slant range geometry. **2.** Denote **3 effects** induced by the use of the slant range geometry. Give a detailed answer (use a sketch if necessary).	**(8 P)** *2 p* *6 p*
c. A SAR system possesses a better azimuth resolution than a SLAR system. Why?	**(2 P)**
d. The SAR resolutions (range / azimuth) do not depend on the sensor altitude. **1.** Explain why for the range direction. **2.** Explain why for the azimuth direction. **3.** Explain why space-borne sensors do typically possess a lower spatial resolution than airborne sensors.	**(4 P)** *1 p* *1 p* *2 p*
e. Explain the differences in backscattering between short wavelength (e.g. X-band) and long wavelength (e.g. L-/P-band) with respect to surface roughness and penetration capabilities.	**(4 P)**
f. Make a simple proposal describing how to map a flooding area using **SAR images**.	**(4 P)**
g. SAR Polarimetry measures 4 channels instead of only 1. **1.** Explain what should be added in the hardware. **2.** How is it possible to obtain 4 channels using only 2 pulses?	**(3 P)** *2 p* *1 p*

2. SAR Interferometry	(30 P)
There are two important applications in SAR interferometry: digital surface model generation and ground deformation measurement.	
a. Outline the imaging geometry of an InSAR system (sketch!) and denote all important parameters (e.g. slant-range, azimuth, sensor position, etc.).	**(5 P)**
b. Describe all processing steps that need to be performed in order to generate a digital surface model.	**(5 P)**
c. For generating digital surface models, the optimum is a single-pass InSAR system. What is a single-pass InSAR system? **1.** Why is it preferable compared to a repeat-pass system for that case? **2.** Explain briefly the two missions that have been conducted to generate a global Earth DEM.	**(5 P)** *2 p* *3 p*
d. What is the height precision that can be achieved with modern sensors?	**(1 P)**
e. For deformation measurements with DInSAR, a repeat-pass system is needed. **1.** Explain why it is necessary to use such system. **2.** What is the optimum baseline for DInSAR measurements?	**(3 P)** *2 p* *1 p*
f. Determining ground deformation is one of the greatest success stories of the use of SAR imagery. **1.** Why? **2.** On which system parameters does the deformation estimation depend? **3.** Which amount of deformation can we obtain by using an X-band system (with e.g. 3 cm wavelength)?	**(5 P)** *3 p* *1 p* *1 p*
g. Generally speaking, a deformation pattern has to be described by three-dimensional displacement vectors at each pixel of the image. Which component of this vector is measured by applying a DInSAR approach?	**(2 P)**
h. Make a simple proposal describing how a slow deformation process (that is variable in time) could be analysed by using SAR imagery.	**(4 P)**

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!