Examination / Tentamen
Introduction to Earth Observation (AE2–E02)
Faculty of Aerospace Engineering
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SAMPLE-QUESTIONS

Question 1

Prove that a plane polarized electromagnetic wave with angular frequency ω, wavelength λ, and amplitude E_0 satisfies the Maxwell equations

$$\begin{aligned}
\nabla \cdot \mathbf{E} &= 0 \\
\nabla \cdot \mathbf{B} &= 0 \\
\nabla \times \mathbf{E} &= -\dot{\mathbf{B}} \\
\nabla \times \mathbf{B} &= \epsilon_0 \mu_0 \dot{\mathbf{E}}
\end{aligned} \tag{1}$$

Question 1

Give a definition of a black body. Which parameter will have the value 1 if an object is a black body?

Question 1

We have a noisy time series of equally sampled observations, and suspect that there will be a dominant sinusoidal signal in the time series. Which transform will be most suitable to detect this signal from the time series?

Question 1

a. Explain how the spatial resolution of a sensor depends on the flying height, the focal length of the objective lens, the diameter of the objective lens, the speed of the platform and the size of the detector.

b. Give a reasonable estimate for the diameter of the objective lens of a near-infrared sensor that should provide a spatial resolution of 10 m, when operated at 700km flying height.

Question 1

Explain how diffraction can be exploited to separate radiation of different wavelengths in a multi-spectral sensor. What is the limitation of this technique?

Question 1

What is the idea behind thermal inertia mapping? Which are the parameters in a simple model for thermal inertia mapping?

Question 1

Explain why radar altimeters are usually pluse-limited, whereas laser profilers are beam-limited.

Question 1

State whether the following statements are True or False. You must justify your answer with a short explanation (the right answer with a wrong explanation will be marked incorrect, and vice versa).

a. One of the disadvantages of an airborne platform is that you often obtain a much lower spatial resolution compared to satellite-based measurements.

b. One of the advantages of using an airborne platform is that you can usually obtain a continuous data stream over long time spans.

c. While a polar orbiting satellite is beneficial for many Earth observing missions, one of the drawbacks is that it's orientation to sun is constantly changing.

d. Assuming a spherical Earth with uniform density, there is only one combination of altitude and inclination that will result in a satellite flying in a geostationary orbit.

Question 1

The mission requirements for a hypothetical Earth observation mission are as follows:

- The satellite should be in a low Earth orbit (i.e., 250–800km altitude)

- Measurements should at a minimum cover latitudes of ± 60 degrees

- Measurements over the same locations are required every 10 days

- The longitudinal spacing of the measurements should be at least 200 km, i.e., the ground ground track separation at the equator should be 200 km.

Assume a spherical Earth (radius 6378 km) with uniform density. Is this possible with a single satellite? If not, describe a scenario with multiple satellites that might satisfy these requirements.