F7003R Optics and Radar Based Observations, 7.5 ECTS

Problems Part 3 (4 points)
Propagation effects. Targets.

1 (1 point)
a) Radar performance is affected by the following phenomena: atmospheric attenuation, surface reflection, diffraction and refraction. Discuss these phenomena, their dependence on the transmitted frequency and give examples.

b) Explain why radars are seldom operated at or near a frequency of 22 GHz and 60 GHz.

2 (1 point)
a) Explain the behaviour of the normalized radar cross section (RCS) of a sphere as a function of its circumference measured in wavelengths for Rayleigh, Mie and optical regions.
What is the reason for the oscillations in the Mie region?
Give examples of the targets for these regions.

b) If you were to design a target to have low specular RCS, how would you proceed?

3 (1 point)
Comment how the radar parameters listed below affect radar performance when detection is limited by (I) surface clutter and by (II) receiver noise.

The radar parameters are: (1) pulse width, (b) antenna gain, (c) transmitter power, (d) number of pulses returned from the target, (e) system losses, and (f) sensitivity of the maximum detection range to changes in the radar cross section.

4 (1 point)
I. M. Reid (2015) reviews medium-frequency and high-frequency radars for studies of the atmosphere at altitudes 50 - 110 km.

a) Discuss two main mechanisms behind the coherent echoes at altitudes 50 – 110 km.

b) What does determine the choice of the operational frequency for these measurements and the optimal pulse repetition frequency?

c) Discuss the main principles of the space antenna techniques. What are the advantages and limitations?

d) Explain the term "apparent" velocity and why it appears to be higher than the "true" velocity.

e) What is the major deficiency of the full correlation analysis for MF/HF radars?