Midterm Exam – ROWAN UNIVERSITY – Radar Systems
Professor Blosfelds
DUE October 31st at 6:30 pm
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Detection of a target in clutter

1. A surface search radar has the following characteristics:
    i. Frequency = 5 GHz (C-Band - vertical polarization)
    ii. Peak power = 5 kW
    iii. Circular phased-array – diameter = 1.00 meters
    iv. Noise Figure = 3 dB
    v. Total System Losses = 10 dB
    vi. Duty factor = 5%
    vii. Dwell length or processing time = 1.0 ms
    viii. Bandwidth = 1 MHz

    a. (30 pts) **Generate the SNR** (in dB) at 20 km for a helicopter with a 1 m^2 RCS. Assume maximum antenna gain towards the target, antenna gain is the same for transmit and receive, and unity propagation. For antenna gain, please use the equation from my Class 2 notes (Slide 12 and 20). If a SNR of 15 dB is required to detect the target, **is the target detectable**?

    b. (30 pts) **Generate CNR** at 20 km, **show calculations for generating clutter cross section**. For circular arrays, beamwidth (in radians) can be estimated by λ/D where D is the diameter in meters. Assume maximum antenna gain towards clutter area.
        1. Sea state 3, grazing angle = 0.125 degrees (use the NRL Clutter model to calculate the mean reflectivity) (the pulsewidth for calculating the length of the clutter area is 1/B where B is the bandwidth of 1 MHz).

    c. (20 pts) **Generate S/(C+N)** at 20 km. If a S/(C+N) of 15 dB is required to detect the target**, is the target detectable**?

    d. (20 pts) We understand that the sea clutter can fluctuate. **What is the mean sea clutter reflectivity that would result in a S/(C+N) of exactly 15 dB?**

MIDTERM submission must include the following:

1.

a. **SNR at 20 km** (in dB) = _____
   Is the target detectable? Y or N

b. **CNR at 20 km** (in dB) = _____
   Clutter cross section (in dBm^2) **= _____**

c. **S/(C+N) at 20 km** (in dB) = _____
   Is the target detectable? Y or N

d. **Mean sea clutter reflectivity** (in dBm^2/m^2) = _____