

Detection of a target in clutter

1. A surface search radar has the following characteristics:
 - i. Frequency = 10 GHz (X-Band)
 - ii. Peak power = 10 kW
 - iii. Circular phased-array – diameter = 0.81 meters
 - iv. Noise Figure = 4 dB
 - v. Total System Losses = 10 dB
 - vi. Duty factor = 2%
 - vii. Dwell length or processing time = 0.5 ms
 - viii. Bandwidth = 1 MHz
- a. (30 pts) **Generate the SNR** (in dB) at 20 km for a helicopter with a 1 m² RCS. Assume maximum antenna gain towards the target, antenna gain is the same for transmit and receive, and unity propagation. 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 sea clutter reflectivity that would result in a S/(C+N) of exactly 15 dB?**