Tutorial 3

Chapter 7

7. Part of the significance of choosing the probability density function used to model target RCS (or clutter or other interference) is that the differences in the "tails" of the PDF can have a significant impact on the probability of observing relatively large signal values, sometimes called signal "spikes." Recall that the probability that a random variable x described by a PDF $p_x(x)$ exceeds some value T is given by:

$$P\{x > T\} = \int_T^{+\infty} p_x(x)\,dx$$

7.5.1 N=(thita/spped)*PRF convert speed to rads/sec

Consider RCS data with a mean value (linear scale) of 1.0. Compute the probability that the RCS σ is greater than 2 when an exponential PDF is a good model for the RCS statistics and again when a fourth-degree chi-square is a good model for the statistics.

10. The ASR-9 is a common airport surveillance radar in the United States. It has an RF of 2.8 GHz, 3 dB azimuth beamwidth θ_3 of 1.4°, and a rotation rate Ω of 12.5 revolutions per minute. Consider an aircraft at a range of 50 nmi (nautical miles). Assume the PRF is chosen to give an unambiguous range of 60 nmi. How many pulses will be transmitted during the time the aircraft is within the 3 dB mainlobe of the antenna on a single rotation? (This will be considered a single "scan" of the aircraft by the radar.)

11. Continuing problem 10, assume the aircraft is a Boeing 757 with a length of about 47 m and a wingspan of about 38 m, flying broadside to the radar at 120 knots. In the time the aircraft is in the mainbeam of the antenna on a single scan, what will be the change in the aspect angle, Δθ, between the radar and aircraft? Based on this result, should pulse-to-pulse or scan-to-scan decorrelation be assumed for the pulse echoes received on a single scan?

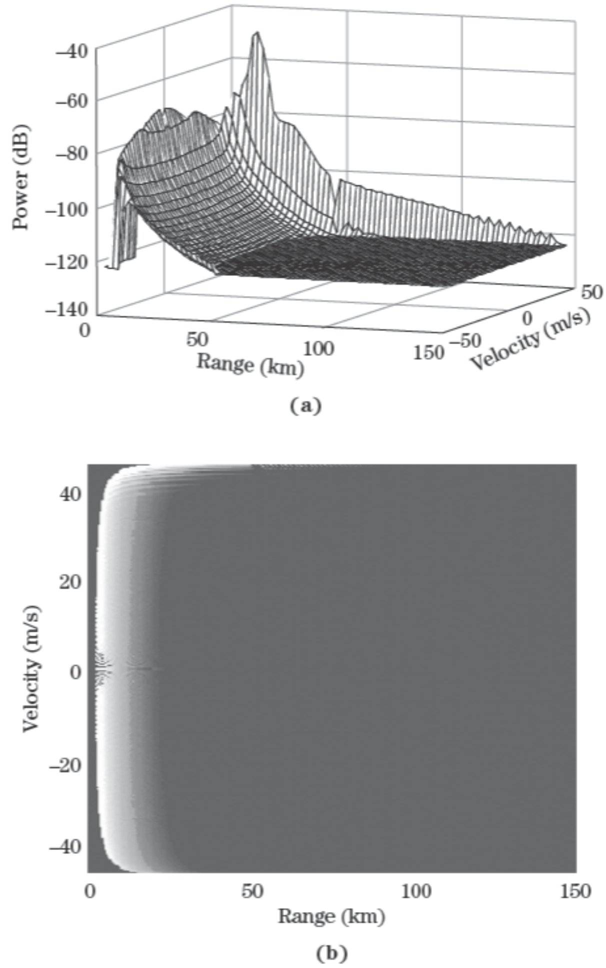
Change in anglw=c/Lf=lamda/2L---- eq 7.18

Chapter 8

17. Consider a radar with a PRF of 5 kHz. What is the maximum unambiguous range, R_{ua}, of this radar, in km? If a target is located at a range of 50 miles, how many pulses will the radar have transmitted before the first echo from the target arrives? What will be the apparent range of the target in kilometers? (The apparent range is the range corresponding to the time delay from the most recent pulse transmission time to the arrival of the target echo from a previous pulse once steady state is achieved.)

18. Consider an airborne radar traveling straight, level, and forward at 200 mph at an altitude of 30,000 feet. The antenna is pointed at an azimuth angle of 0◦ and an elevation angle of −20◦. Sketch the approximate unaliased range-velocity distribution of the ground clutter in a format similar to that of Figure 8-23b. The range axis of the sketch should cover 0 to 100 km, and the velocity axis should cover $\pm v_{max}$, where v_{max} is the maximum possible radial velocity in m/s that could be observed from scatterers in front of the radar. Indicate where the main lobe clutter is located on the sketch.

FIGURE 8-23 ■ Simulated range-velocity distribution for a stationary clutter observed from a moving radar (see text for details). (a) Three-dimensional display. (b) Plan view.



19. Suppose the radar in problem 18 has an RF of 10 GHz and a PRF of 3 kHz. What are the unambiguous range, R_{ua} , and unambiguous velocity, v_{ua}? Sketch the approximate aliased range-velocity distribution of the ground clutter in a format similar to that of Figure 8-25. The range axis of the sketch should cover 0 to R_{ua}, and the velocity axis should cover $\pm v_{ua}$. Indicate where the main lobe clutter is located on the sketch.