INTRODUCTION TO RADAR SYSTEMS

UNIT–III

Lecture–5

Angular Accuracy

- The angular accuracy of tracking radar will be influenced by such factors as the mechanical properties of the radar antenna and pedestal, the method by which the angular position of the antenna is measured, the quality of the servo system, the stability of the electronic circuits, the noise level of the receiver, the antenna beamwidth, atmospheric fluctuations, and the reflection characteristics of the target.

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- These factors can degrade the tracking accuracy by causing the antenna beam to fluctuate in a random manner about the true target path.
- These noise like fluctuations are sometimes called tracking noise, or jitter. In many cases the two factors which ultimately limit the angular accuracy of practical tracking radars are the mechanical errors and the target reflectivity characteristics.

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- A simple radar target such as a smooth sphere will not cause degradation of the angular-tracking accuracy.
- The radar cross section of a sphere is independent of the aspect at which it is viewed; consequently, its echo will not fluctuate with time. The same is true, in general, of a radar beacon if its antenna pattern is omni-directional.
- However, most radar targets are of a more complex nature than the sphere.

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- The amplitude of the echo signal from a complex target may vary over wide limits as the aspect changes with respect to the radar.
- In addition, the effective center of radar reflection may also change. Both of these effects—amplitude fluctuations and wandering of the radar center of reflection—as well as the limitation imposed by receiver noise can limit the tracking accuracy.

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- Amplitude fluctuations: A complex target such as an aircraft or a ship may be considered as a number of independent scattering elements. The echo signal can be represented as the vector addition of the contributions from the individual scatterers.

  If the target aspect changes with respect to the radar—as might occur because of motion of the target, or turbulence in the case of aircraft targets

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—the relative phase and amplitude relationships of the contributions from the individual scatterers also change.

Amplitude fluctuations of the echo signal are important in the design of the lobeswitching radar and the conical-scan radar but are of little consequence to the monopulse tracker.

Both the conical-scan tracker and the lobe-switching tracker require a finite time to obtain a measurement of the angle error.

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The power-spectral-density function is useful for describing the effect of amplitude fluctuations on the performance of a conical-scan or lobe-switching tracker.

This time corresponds in the conical-scan tracker to at least one revolution of the antenna beam.

- With lobe switching, the minimum time is that necessary to obtain echoes at the four successive angular positions.

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- The echo signal from complex targets is best described in statistical terms.
- Some of the more useful statistical descriptions that have been applied to cross sections are the cumulative probability distribution, the autocorrelation function, and the power spectral density.