INTRODUCTION TO RADAR SYSTEMS

UNIT-IV

Lecture-1

DETECTION OF RADAR SIGNALS IN NOISE

- The two basic operations performed by radar are (1) detection of the presence of reflecting objects, and (2) extraction of information from the received waveform to obtain such target data as position, velocity, and perhaps size.
- The operations of detection and extraction may be performed separately and in either order, although a radar that is a good detection device is usually a good radar for extracting information, and vice versa.

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- Three of the basic problems of detection discussed in the present chapter are (1) the specification of the optimum receiver characteristic for the detection of weak signals in noise, (2) the comparison of practical receivers with the ideal receiver, and (3) the selection of a criterion for recognizing the presence or absence of a signal.
- The question of the optimum receiver for detecting weak signals in noise is considered from several equivalent, but

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- (1) the matched filter, (2) the correlation receiver, (3) the inverse-probability receiver, and (4) the likelihood-ratio receiver.
- The radar detection process consists of deciding whether the output of the radar receiver is due to noise alone or to signal-plus-noise.
- Criteria for making this decision are based on statistical hypotheses testing and include the Neyman-Pearson, the Ideal, and the Sequential tests.

Matched-filter Receiver

- A network whose frequency-response function maximizes the output peak – signal-to-mean-noise (power) ratio is called a matched filter.
- The matched filter is an optimum method for the detection of signals in noise.
- The frequency-response function, denoted H(f), expresses the relative amplitude and phase of the output of a network with respect to the input when the input is a pure sinusoid.

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- The amplitude or magnitude H(f) of the frequency-response function is the receiver amplitude pass-band characteristic.
- If the bandwidth of the receiver pass-band is wide compared with that occupied by the signal energy, extraneous noise is introduced by the excess bandwidth and lowers the output signal-to-noise ratio.
- The receiver frequency-response function is applied from the antenna terminals to the output of the IF amplifier.

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- The noise that accompanies the signal is assumed to be stationary and to have a uniform spectrum (white noise). It need not be Gaussian. If the noise is not white, may be modified.
- The filter whose frequency –response function has been called the North filter, the conjugate filter, or more usually the matched filter.
- It has also been called the Fourier transform criterion. It should not be confused with the circuit-theory concept of impedance matching, which maximizes the power transfer rather than the signal-to-noise ratio.

Matched-filter Characteristic.

- The frequency-response function of the matched filter has been derived by a number of authors using either the calculus of variations or the Schwartz inequality.
- The interesting property of the matched filter is that no matter what the shape of the input-signal waveform, the maximum ratio of the peak signal power to the mean noise power is simply twice the energy E contained in the signal divided by the noise power per cycle of bandwidth No.