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Commentary

Functioning of an Automatic Radar for Aerial Target

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DESCRIPTION

A radar detects a target by radiating a radio frequency signal and receiving echoes of the same signal, which is reflected back by the target. The radar calculates the bearing of the target from the alignment of its antenna, which was used for transmission as well as for receiving the signal and if an appropriate signal is transmitted, the target range can also be calculated by using the time interval between transmission and reception of the signal. Depending on the type of radar, it may also be possible, by analysing the doppler shift in the returned signal, to deduce radial velocity of the target's. In order to achieve these stated target parameters several actions are performed by a radar which can be explained in stage wise manner for ease of understanding.

A simplified radar design can be considered as consisting of four segments, each of which can be further divided into smaller blocks the transmitter channel, the receiver channel, common components for both channels and the processing stage. The processing stage is responsible for signal processing, tracking and displaying information for the operator to act upon. Two radio frequency oscillators are common to both the receive as well as transmit channels. The coherent local oscillator (coho), provides the synchronous detector with a coherent reference signal for further use during the detection phase for the received signal. The frequency of the coho is up-converted to that of frequency being transmitted by mixing it with the high frequency output of the stable local oscillator (stalo). The coho, stalo and up converter collectively are known as receiver-exciter that is responsible for providing three output signals, the transmission signal, a local oscillator signal for down conversion of the signal being received and a reference signal for further use in phase detection. Advantage of using such arrangement is that it makes it possible for the transmit channel to have fewer number of components.

The transmitter stage of the radar involves three operations. First, the stalo output up-converts the coho's output to transmission frequency. Up-conversion consists of mixing the two signals and filtering out of undesirable mixing products, such as sidebands and harmonics. Secondly, since for a radio frequency signal, the processes of covering the distance to and from the target and subsequent back scattering, results in severe atmospheric attenuation of the signal, therefore it is essential that the transmitted signal be of as high power as possible which in turn ensures that the received signal has a higher probability of detection. For achieving this, the low power signal to be transmitted is made to pass through a power amplifier. The third module is an output modulator. In order to carry out range measurements, radar transmits its signal in the form of pulses. The frequency of emission of these pulse is known radar's Pulse Repetitional Frequency (PRF) and the period of each pulse the Pulse Width (PW). Once the radar transmits the signal and target backscatters it, receiver channel receives it. Radar's receiver channel after receiving the reflected signal down-converts it by mixing it with the output given by stalo.

CONCLUSION

The signal so produced is filtered, to the radar Intermediate Frequency (IF). The IF is identical to the coho frequency and this is the frequency at which the majority of the receiver modules work. Following this down conversion the signal is amplified and given as an input to the quadrature detector. The two outputs of this channel are required for calculation of doppler shifts. Depending on the direction target motion, the sign of doppler shift will be either positive or negative. However, with the removal of the coho signal the sign of doppler shift is lost and only a positive frequency left. The fourth stage of the radar, the processor, consists of a number of processes that are dictated by the intended use of the radar. Largely, this stage concern with the application of signal processing methods to the target signal in order to extract the maximum amount of information about the target.

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