Concept of Coherence

Figure 1: non-coherent pulses with random phase from pulse to pulse
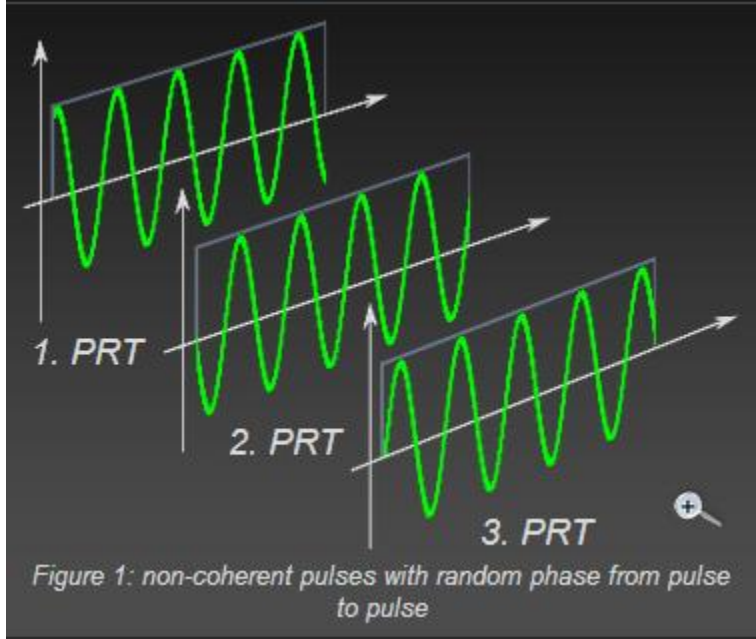
Figure 1: non-coherent pulses with random phase from pulse to pulse

What is Coherent Radar?

The transmitted pulse's of coherent radar have all defined phase angles to a reference. Whether a radar set is coherent or non-coherent always depend on the transmitter. As a transmitter different systems are used in radar.

Non-coherent Radar Processing

One of the transmitting systems is the POT (Power Oscillator Transmitter) which is self oscillating. When such a device is switched on and off as a result of modulation by the rectangular modulating pulse, the starting phase of each pulse is not the same for the different successive pulses. The starting phase is a random function related to the start up process of the oscillator.

Notice: Self oscillating transmitter gives random phase pulse to pulse and is not coherent!
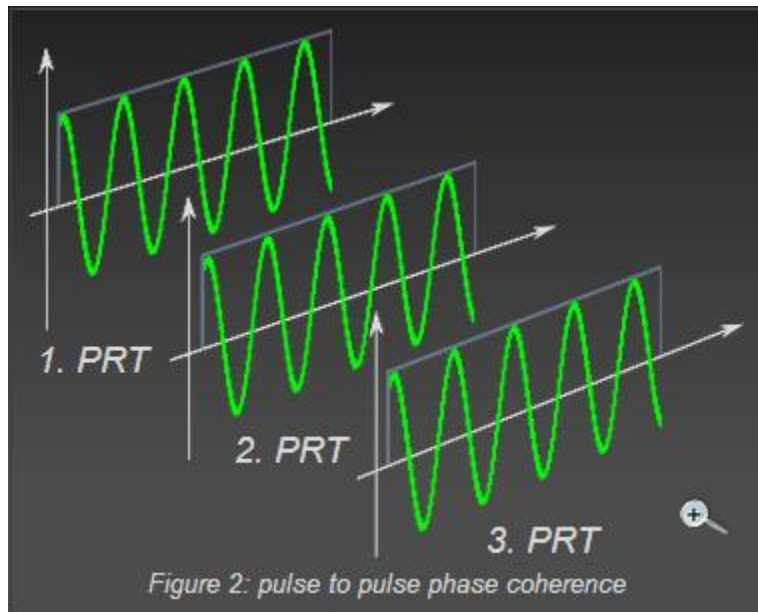
Coherent Radar Processing

Figure 2: pulse to pulse phase coherence

Another transmitter-system is the PAT (Power-Amplifier-Transmitter). In this case, the high-power amplifier is driven by a highly stable continuous RF source, called the waveform generator. Modulating the output stage in response to the PRF does not affect the phase of the driver/RF source. Assuming the RF is a multiple of the PRF (as is normally the case), each pulse starts with the same phase. Systems, which inherently maintain a high level of phase coherence from pulse to pulse, are termed fully coherent. Note that phase coherence is maintained even if the PRF and RF are not locked together (provided the RF source is phase stable). As stated, it is common practice to lock the PRF to the RF phase and this assumption makes it easier to understand the concept of coherence.

Notice: Low Power oscillator and amplifier give same phase pulse to pulse and are a coherent system!

The most important benefit of this system is the ability to differentiate relatively small differences in velocity (which correspond to small differences in phase). This coherent target processing offers Doppler resolution/estimation and provides less interference and signal/noise benefits relative to non-coherent processing.