



# RADAR

BY

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ROLL NO: 49

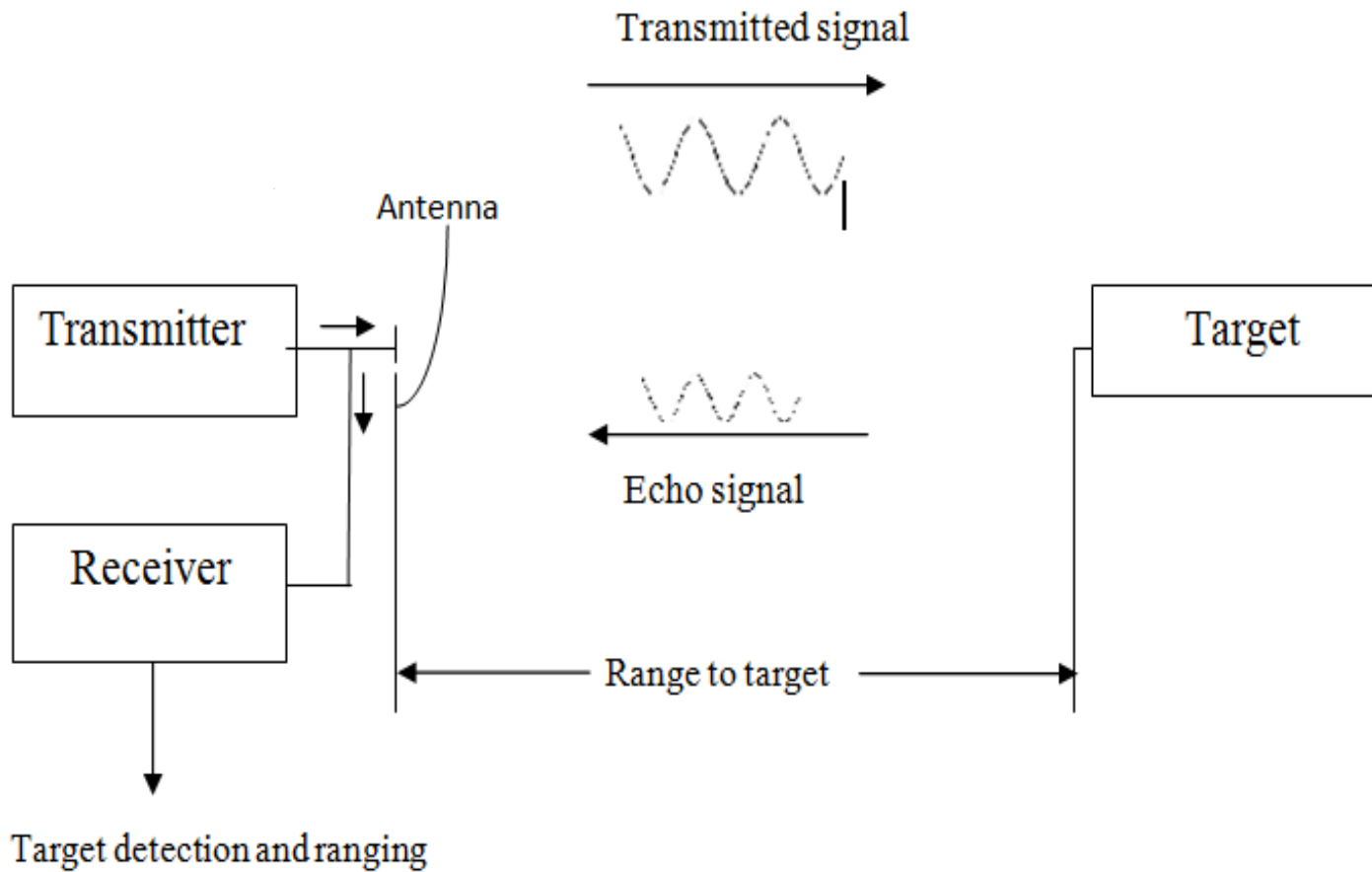
# Introduction

- RADAR is acronym for Radio Detection and Ranging.
- First successfully demonstrated in 1936.
- It uses electromagnetic waves.
- It enjoys wide range of application.

# Literature Survey

- History
- Future Researches

# Principle of Working



# Radar Range Equation

$$R_{\max} = [P_t G \sigma A_e / (4\pi)^2 S_{\min}]^{1/4}$$

$$G = 4\pi A_e / \lambda^2$$

$$A_e = G\lambda^2 / 4\pi$$

$$R_{\max} = [P_t G\lambda^2\sigma / (4\pi)^2 S_{\min}]^{1/4}$$

Where  $P_r$  = power received

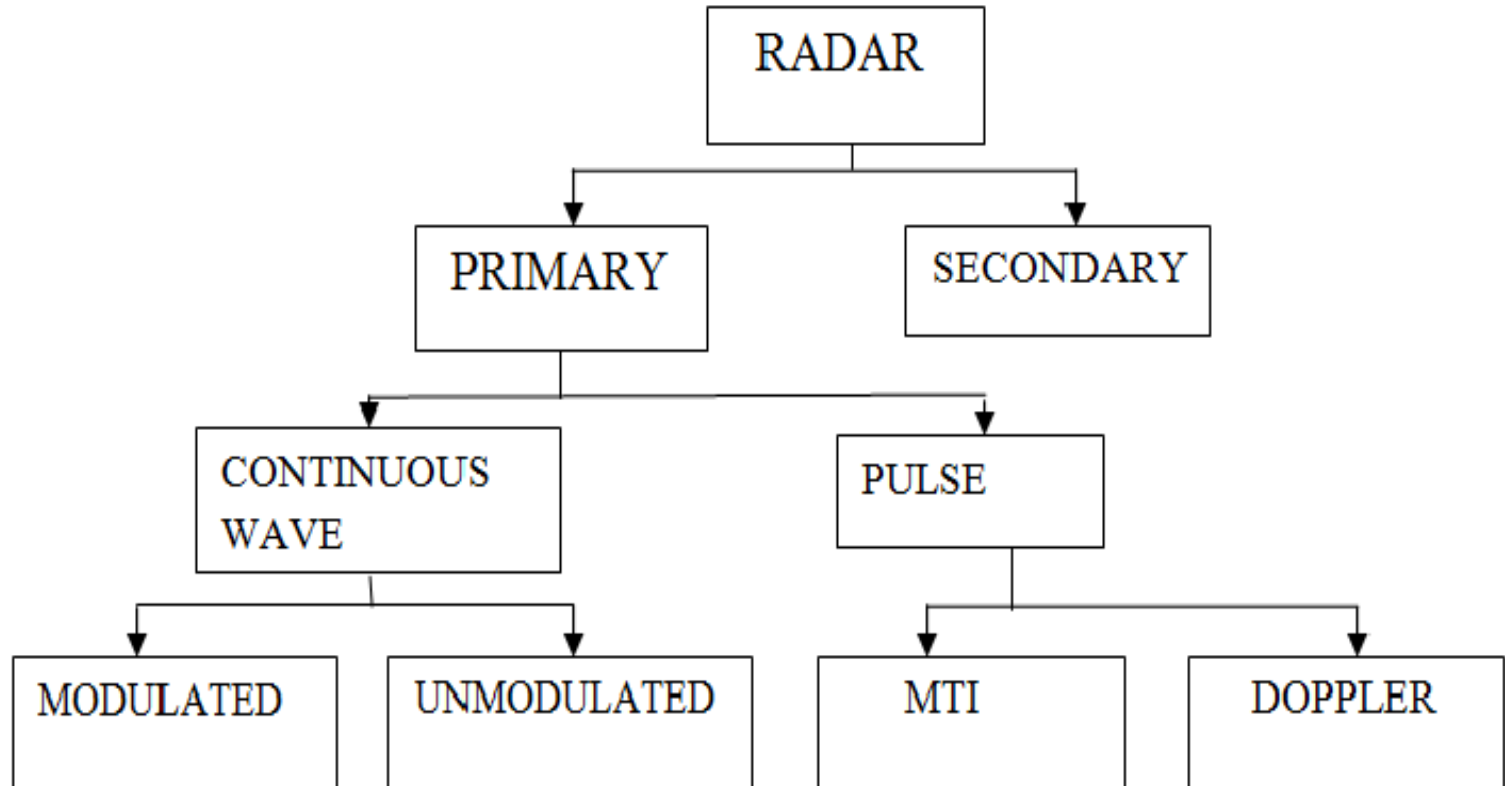
$P_t$  = power transmitted

$G$  = antenna gain

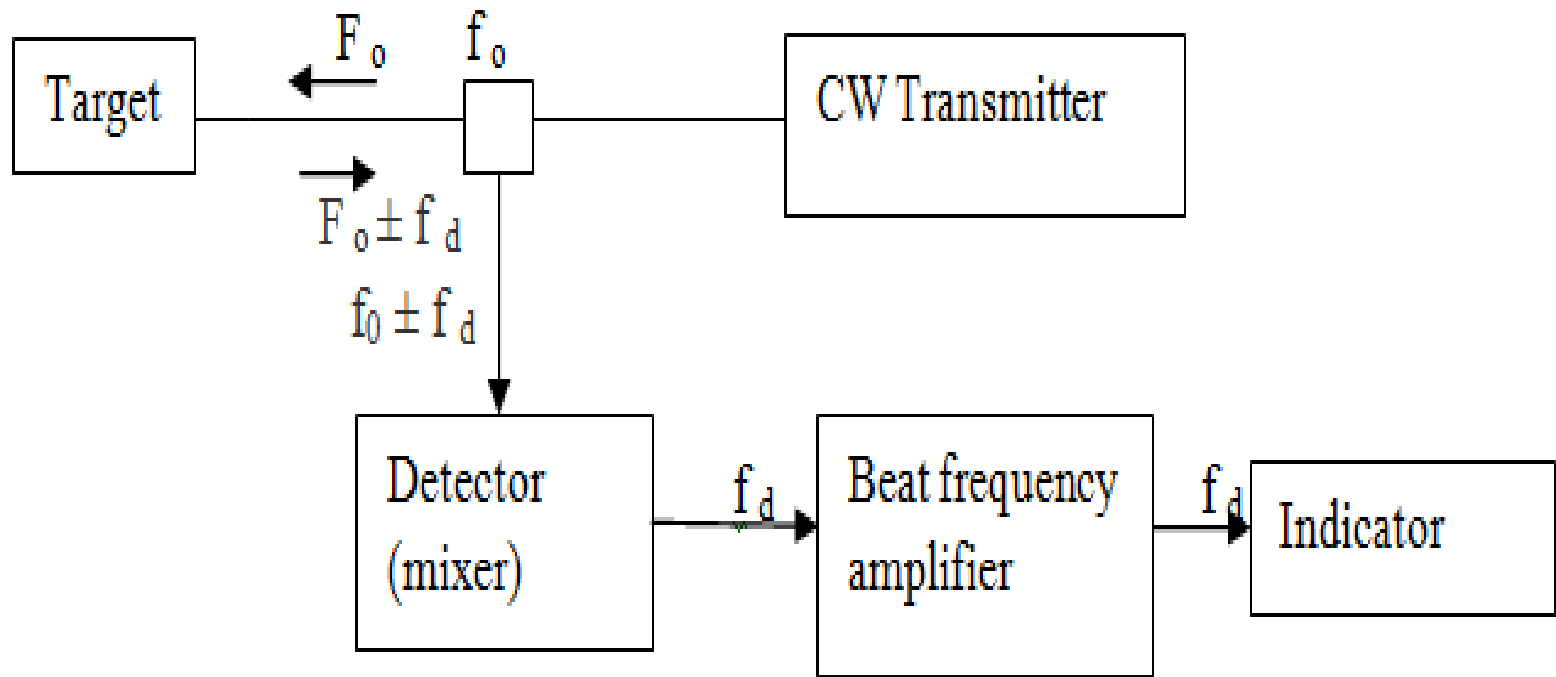
$\sigma$  = radar cross section of target

$A_e$  = effective area

# Types of Radar



# CONTINUOUS WAVE RADAR



# Advantages

- Uses low transmitting power, low power consumption.
- simple circuitry, small in size.

# Disadvantages

- several targets at a given bearing tend to cause confusion.
- Range discrimination can be achieved only by introducing very costly complex circuitry.
- It is not capable of indicating the range of target and can show only its velocity.



# Gated CW Radar

- It operate on the principle of pulsed transmit signal and gated receive path, along with an IF section of the receiver.
- does not pass the entire received pulse of frequency, but only the central component.
- Gated-CW radars have generally been implemented using vector network analyzers (VNAs) as the IF receivers.

# Advantages

- High level of performance, less cost.
- Better accuracy, sensitivity, selectivity.
- Good data acquisition speed.

# Disadvantages

- Experiences additional losses termed duty cycle losses.

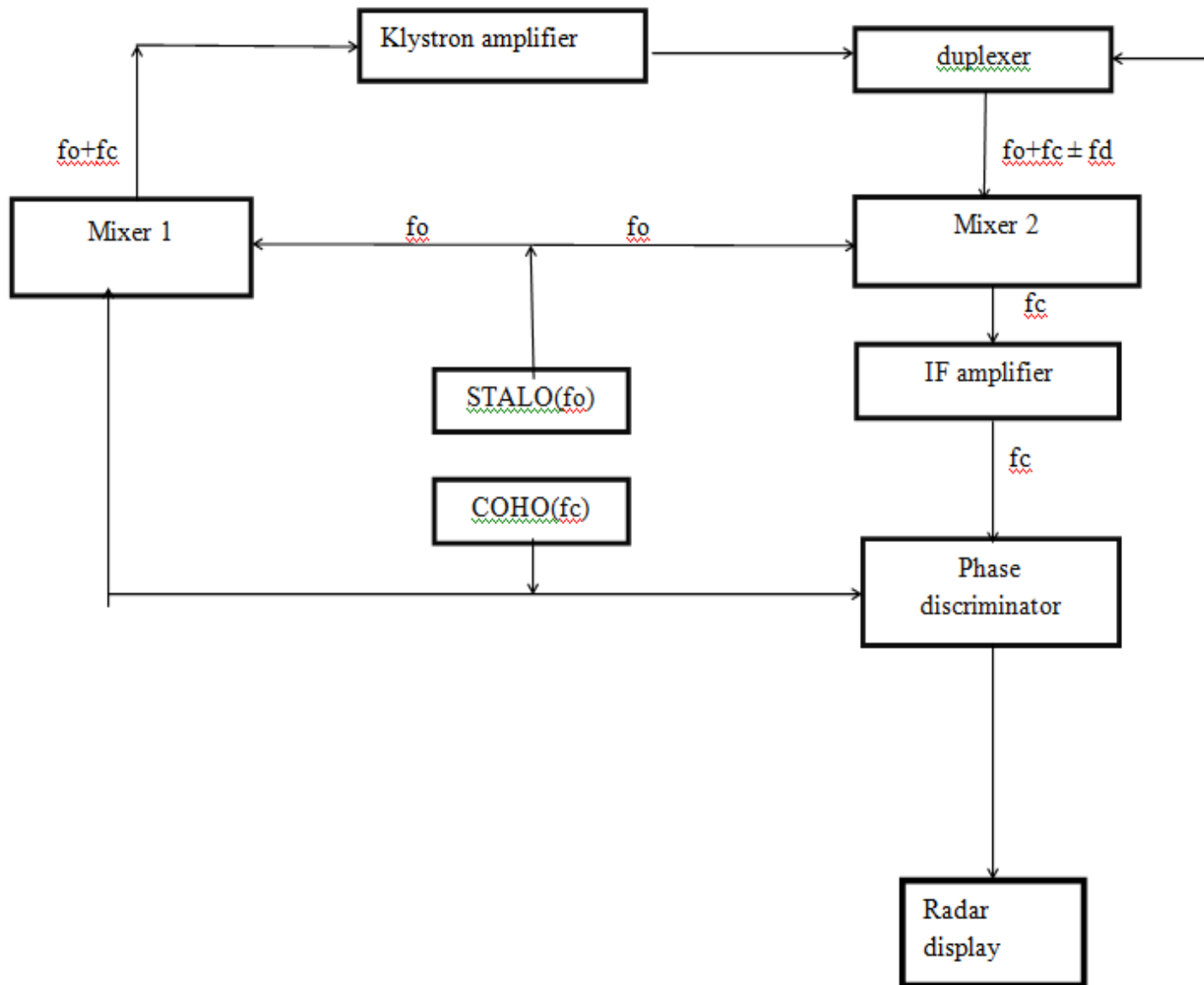
# Pulse Radar

- Pulsed radar transmits high power, high-frequency pulses toward the target.
- Choice of pulse repetition frequency decides the range and resolution of the radar.
- Two broad categories of pulsed radar employing Doppler shifts are Moving Target Indicator Radar and Pulse Doppler Radar.

# Moving Target Indicator Radar

- This radar uses Doppler effect .
- MTI radar distinguishes between moving targets and stationary targets.
- The MTI Radar uses low pulse repetition frequency (PRF) to avoid range ambiguities.
- MTI Radars can have Doppler ambiguities.

# Principal of Working



# MTI Application in UAVS

- UAV Stands for Unmanned Aerial Vehicles
- These aircraft are without pilot on board.
- One specific area of interest that has been closely examined by the UAVB has been in the area of cross-cueing applications Moving Target Indicator (MTI).
- JSTARS and TESARS are two type of UAVS used by US Air force.

# Pulse Doppler Radar

- Pulse Doppler Radar uses high PRF to avoid Doppler ambiguities, but it can have numerous range ambiguities.
- In MTI radar the prf is chosen so that there are no range ambiguities, but there are usually many Doppler ambiguities, or blind speeds.
- A radar that increases its prf high enough to avoid the problem of blind speeds is called a pulse Doppler radar.

# Resolving Velocity Ambiguity

- Earlier multiple prf was used.
- Velocity ambiguity can be resolved by transmitting many carrier frequency.
- $f_{nd} = n f_r + f'_{nd}$

Where  $f'_{nd}$  is doppler frequency

$$f_{nd} = 2V_t f_n / c$$

$$f_r = 2v_n f_n / c$$

$$\text{Therefore } V_t = n V_n + V'_{nt}$$



# Comparison

PARAMETER	PULSE RADAR	CONTINUOUS WAVE RADAR
TYPE OF SIGNAL	Modulated	Modulated and Unmodulated
ANTENNA	Duplexer	Separate Antennas
RANGE	Indicates Range	Don't indicate Range
TRANSMITTING POWER	high	Low
CIRCUIT	Complicated	Simple
STATIONARY TARGET	Affects	Doesn't affect
MAXIMUM RANGE	High	Low
PRACTICAL APPLICATION	More applications	Less applications
MANY TARGETS	Does not get affected	Does get affected

# Conclusion

- RADAR is used to find velocity, range and position of the object.
- Advantage of RADAR is that it provide superior penetration capability through any type of weather condition.
- LIDAR is advanced type of radar which uses visible light from laser.

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THANK YOU