



# **SNS COLLEGE OF TECHNOLOGY**

Coimbatore-35  
An Autonomous Institution



Accredited by NBA – AICTE and Accredited by NAAC – UGC with 'A++' Grade  
Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

## **DEPARTMENT OF AEROSPACE ENGINEERING**

### **19AST101 – INTRODUCTION TO AEROSPACE ENGINEERING I YEAR II SEM**

#### **UNIT-V AIRCRAFT INSTRUMENTATION TOPIC: RADAR & SONAR**

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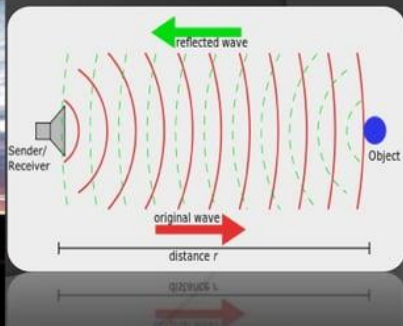




WELCOME  
TO OUR PRESENTATION  
RADIO & SOUND NAVIGATION

SONAR

RADAR





# RADAR (RADIO DETECTION AND RANGING)

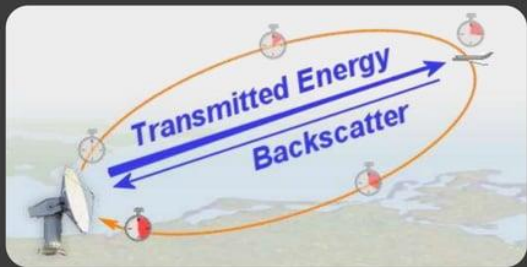
System for detecting the

- Direction
- distance
- speed of aircrafts
- Ships
- and other objects





## Principle of Operation

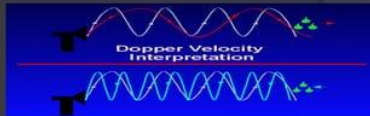
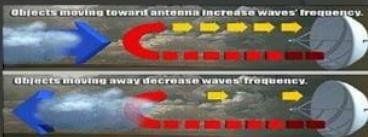
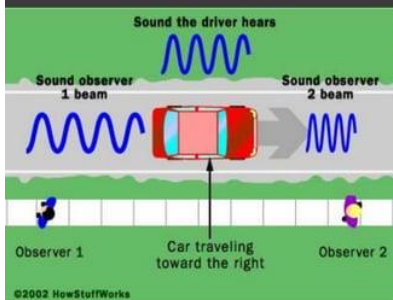


- Reflection of electromagnetic waves
- Measurement of running time of transmitted pulses



# Doppler Effect

- In radar technology the Doppler Effect is using for two tasks:
  - 1) Speed measuring and
  - 2) MTI - Moving Target Indication





## Developed in World War II & Usage in Today

- Used to locate incoming enemy bomb raids
- Also used to map the ground
- Used as Speedometers for Police officers to tell how fast someone is going.
- Used in the Navy, for tracking enemies, missiles & etc.





## Functions of Radar

- RADAR is a method of using electromagnetic waves to remote-sense the position, velocity and identifying characteristics of targets.

### Direction Determination





## Radar Equation & Frequency Bands:

➤ The power  $P_r$  returning to the receiving antenna is given by the radar equation:

$$P_r = \frac{P_t G_t A_r \sigma F^4}{(4\pi)^2 R_t^2 R_r^2}$$

where

$P_t$  = transmitter power

$G_t$  = gain of the transmitting antenna

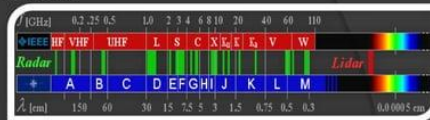
$A_r$  = effective aperture (area) of the receiving antenna

$\sigma$  = radar cross section, or scattering coefficient of the target

$F$  = pattern propagation factor

$R_t$  = distance from the transmitter to the target

$R_r$  = distance from the target to the receiver.

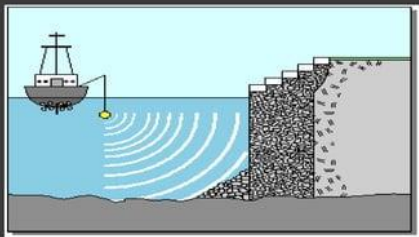






## SONAR (Sound Navigation And Ranging)

- A sonar device will send out sub-surfaces sound waves and listen for returning echoes.
- The ultrasonic vibrations are sent from the ship.





## Principle of sonar

- When ultrasonic's waves is transmitted through water, it is reflected by the object in the water and will produce an echo signal.
- from the signal we can estimate distance of the object can be easily calculated.



## Developed in World War II & Usage in Today

- Uses of Sonar during World War 2:
  - Submarine
  - Mines
- Sonar in WWII allowed trade to be re-opened
- Today, Sonar is used mainly for under water searches.
- Used to find small objects
- Sonar is used in the Medical field
- Sonography is used to see within the human body



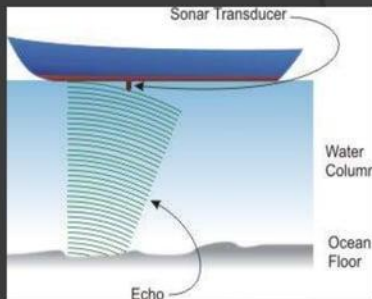
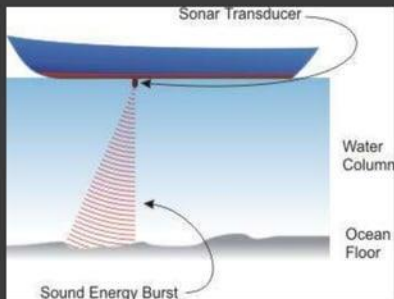
## Frequencies used in navigational **SONAR**

"Modern ultrasonic generators can produce frequencies up to more than several gigahertz (1 GHz = 1 billion Hz)."	1 GHz
"Branch of physics dealing with high-frequency sound waves, usually in the range above 20,000 hertz (Hz)."	20 kHz
"Frequencies for sport fishing sonar are 50 kHz and 200 kHz, although 120 kHz, 455 kHz, and other frequencies are also used."	50, 120, 200, 455 kHz
"Sonar operates in the 10 to 50 kilocycle acoustical frequency range."	10 - 50 kHz
"The DSOG now operates 120 kHz and 200 kHz split-beam sonar systems designed for deeply-towed, near-bottom seafloor imaging and swath phase-bathymetric mapping."	120, 200 kHz



## How SONAR works

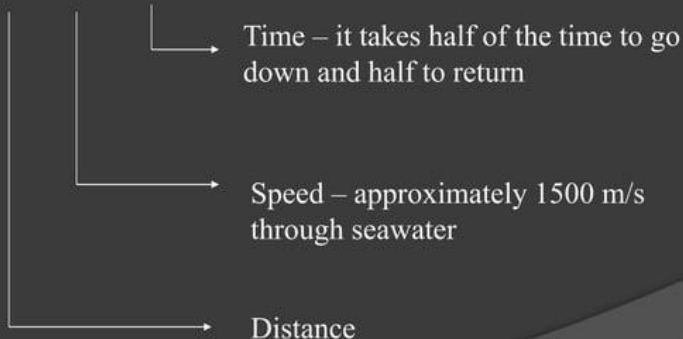
- Sends a burst of high frequency sound waves
- Listens for an echo





## Theory - equation

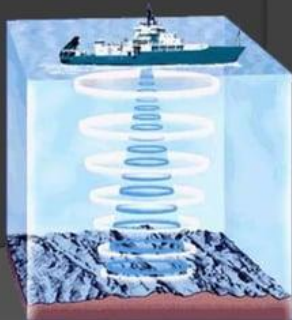
●  $d = s \times (t/2)$





## Sonar transducers

- Piezo composite transducers are an excellent choice for sonar applications. Transducers made from piezo composite are highly efficient and inherently broadband.
- Echo sounding





# Conclusion:

- **Radar** is a way to detect and study far off objects by transmitting a radio pulse in the direction of the target and observing the reflection of the wave.
- The sonar principle is to locate an object by estimating the acoustic travel time and direction of arrival between sensor and object.
- Typical sonar are for fish finding, imaging and mapping of the seafloor, military and navigation.





THANK YOU