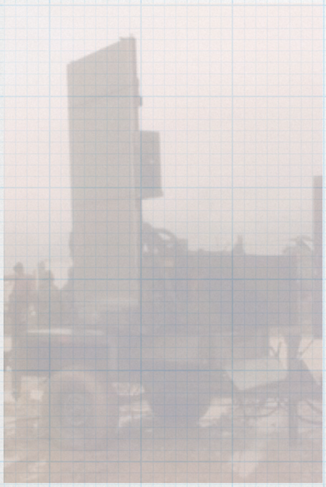
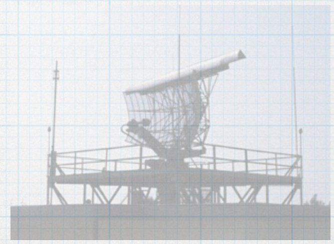
ECE 678

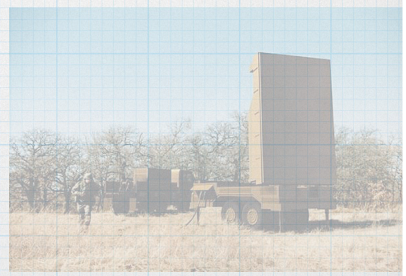
Radar Engineering
Fall 2024

Session 1

Prof. Mark R. Bell
Purdue University







1.1

RAdio Detection And Ranging

RADAR

It has become so commonplace that the acronym RADAR has evolved into a common noun: radar.

1.2

1.3

A Little History...

- Bats, dolphins, whales, and some birds have been doing this for a long time.
- Allied Submarine Detection Investigation Committee—World War I (Lord Rutherford)
- In 1922, Marconi suggested radar for ship detection.
- "Radio Fence" experiments at Naval Research Labs in 1930s.

Radar development intensified with outbreak of WW II (1939)

- Royal Radar and Signals Establishment (UK)
- MIT Radiation Laboratory (MIT Lincoln Labs)(MIT Radiation Lab Series—28 volumes documenting WWII radar development.)
- Other US Laboratories (Bell Labs, Stanford)
- Germany also had a radar development program.

1.6

The Pearl Harbor SCR-270 Radar Set

- The Japanese aircraft that attacked Pearl Harbor were detected and tracked by radar while over 100 miles (50 minutes) away.
- Unlikeliness of attack resulted in radar detection not being acted on.

1.7

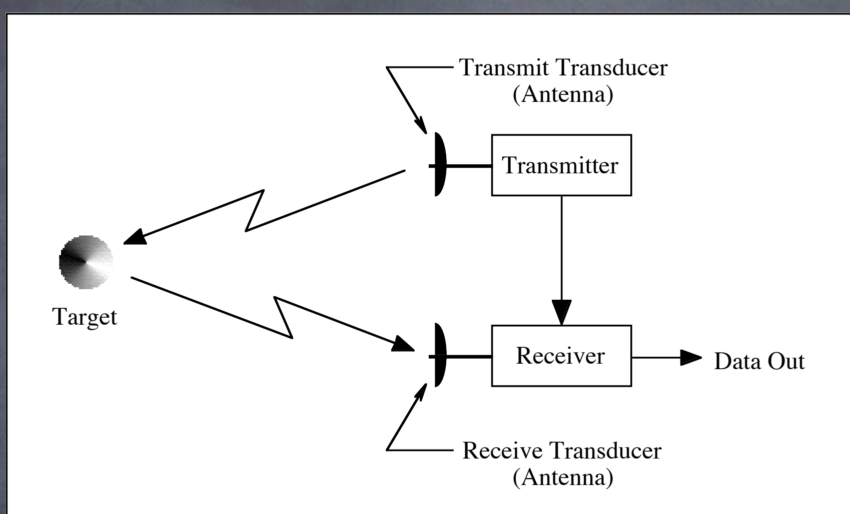
- After WWII, during 1950s–1980s, radar development continued at an intense rate, driven by the Cold War with the Soviet Union.
- In the last 25 years, there has been a renaissance in radar research fueled by new technological (computational) capabilities:
    - Adaptive signal processing
    - Adaptive waveform design
    - MIMO Radar

1.8

How Does a Radar Work?

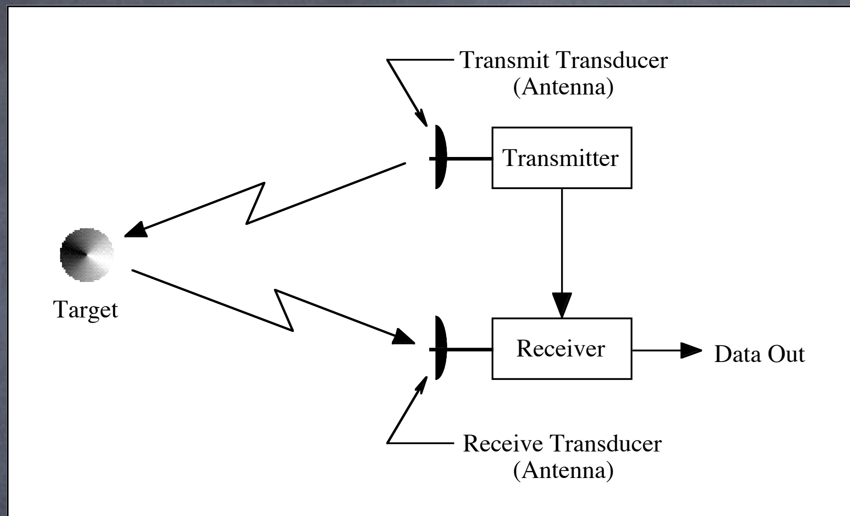
1.9

Pulse-Echo Measurement System



A pulse-echo measurement system is any system that uses the scattering of radiated waves (electromagnetic or acoustic) from an object to obtain information about that object.

Pulse-Echo Measurement System



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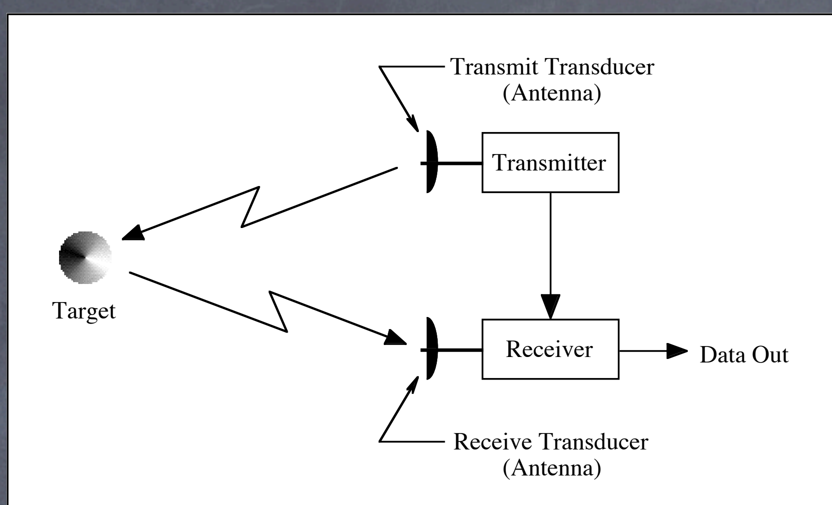


> It consists of

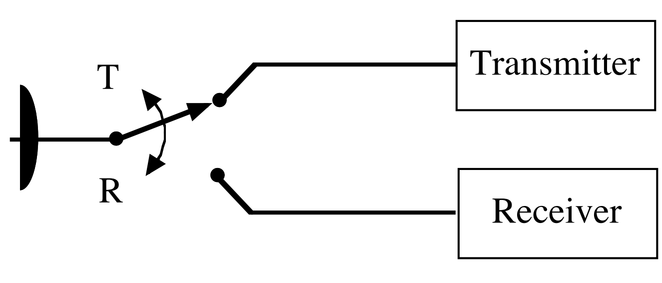
1. Transmitter
2. Transmit Transducer (Antenna)
3. Receive Transducer (Antenna)
4. Receiver

1.12

- Form of transducer depends on radiation:
- RF and Microwaves ---> Antennas
- Optical Radiation ---> Lens, “telescopes”
- Sonar ---> Electromechanical Devices
- Ultrasound---> Piezo-electric transducers
- Geophysical ---> explosives, “thumpers”

1.13

The transmit and receive antenna may or may not be the same physical antenna:



T/R Switch

Radars that use the same antenna for transmit and receive—or have the two antennas co-located— are called <u>monostatic</u> radars.