

# Physical fundamentals of the radar principle

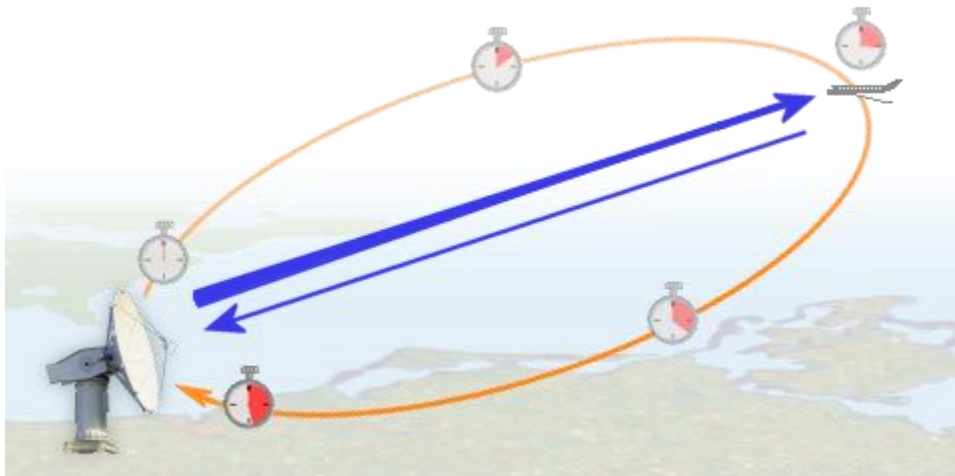


Figure 1: Radar principle: The measuring of a round trip time of a microwave pulse

The basic principle of operation of primary radar is simple to understand. However, the theory can be quite complex. An understanding of the theory is essential in order to be able to specify and operate primary radar systems correctly. The implementation and operation of primary radars systems involve a wide range of disciplines such as building works, heavy mechanical and electrical engineering, high power microwave engineering, and advanced high speed signal and data processing techniques. Some laws of nature have a greater importance here.

Radar measurement of range, or distance, is made possible because of the properties of radiated electromagnetic energy.

## Reflection of electromagnetic waves

The electromagnetic waves are reflected if they meet an electrically leading surface. If these reflected waves are received again at the place of their origin, then that means an obstacle is in the propagation direction.

Electromagnetic energy travels through air at a constant speed, at approximately the speed of light,

300,000 kilometers per second or

186,000 statute miles per second or

162,000 nautical miles per second.

This constant speed allows the determination of the distance between the reflecting objects (airplanes, ships or cars) and the radar site by measuring the running time of the transmitted pulses.

This energy normally travels through space in a straight line, and will vary only slightly because of atmospheric and weather conditions. By using of special radar antennas this energy can be focused into a desired direction. Thus the direction (in azimuth and elevation of the reflecting objects can be measured.

These principles can basically be implemented in a radar system, and allow the determination of the distance, the direction and the height of the reflecting object.

(The effects atmosphere and weather have on the transmitted energy will be discussed later; however, for this discussion on determining range and direction, these effects will be temporarily ignored.)

**Source:**

**<http://www.radartutorial.eu/01.basics/Physical%20fundamentals%20of%20the%20radar%20principle.en.html>**