

Basic Principles of Radar

Introduction

A radar system makes use of high-speed electromagnetic waves to determine the location (distance), the velocity, the direction being travelled, and the elevation (altitude) of both stationary and non-stationary objects. These objects can include weather formations, motor vehicles, ships, aircraft, spacecraft, and even terrain. The original acronym, RADAR, stood for “radio detection and ranging”. The word “radar” is now a universally accepted term in the English language.

Radar Types and Functions (partial list):

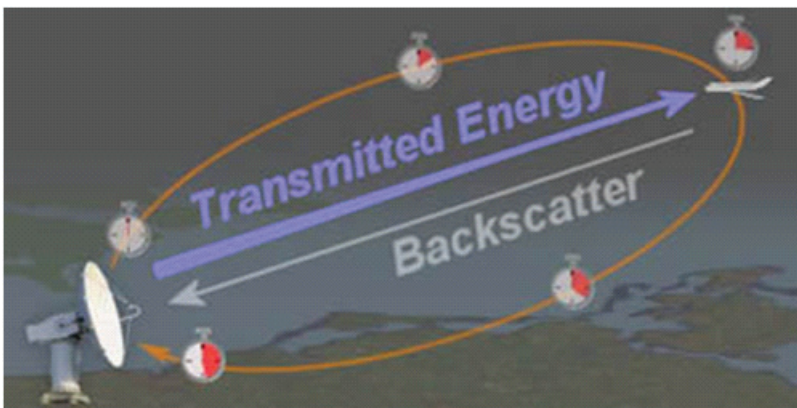
- Navigation
- Space Exploration/Tracking
- Air Traffic Control
- Weather
- Threat Detection (Military)
- Missile Guidance (Military)
- Battlefield and Reconnaissance
- Biological Research
- Automobile Traffic/Speed Detection

Basic Principles

The basic principle of radar operation is simple to understand. A radar system transmits electromagnetic energy and analyzes the energy reflected back to it (by an object). The theory behind radar, on the other hand, is very complex. An understanding of the theory is essential in order to be able to specify and design radar systems correctly. The implementation and operation of any radar system involves a wide range of disciplines such as structures, mechanical and electrical engineering, high power microwave engineering, and advanced high speed signal and data processing techniques. The measurement of an object's range (distance) from the radar antenna is made possible because of these properties of radiated electromagnetic energy:

a. 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.



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Basic Principles of Radar (cont.)

b. 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.

c. This energy normally travels through space in a straight line, and will vary only slightly because of atmospheric and weather conditions.

By using special radar antennas this energy can be focused into a desired direction. Thus the direction (in azimuth and elevation) of the reflecting objects can also be determined.

Each of the above basic principles can be used in the design and implementation of a fully functioning radar system, which therefore allows the distance, the direction and the elevation of the reflecting object to be determined with precision. Electronic versions of the first three (3) chapters of The Basic Principles of Radar can be found in Documents and Downloads. Please proceed to the [Design Resource Center](#) section of the Richardson website for more on "Radar."

Resources

See the entire tutorial at radartutorial.eu/index.en.html.

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