Doppler Radar and Radio Waves: Weather Station Monitoring

Doppler radar uses the Doppler effect to generate velocity data about things that are at a distance. As a microwave signal bounces off of the target, Doppler radar analyzes how motion alters the frequency of the returning signal. The difference provides an accurate measurement of the target's radial component velocity as it relates to the radar. Doppler radar is used in aviation, radio, police radar guns, health care (including radiology), meteorology, and even in Major League Baseball.

The History of Doppler Radar

The term "radar" came from "radio detection and ranging." During the 1930s, both Britain and Germany began researching radar. The initial purpose of radar was to detect ships and other metal objects. It wasn't until the 1940s that interest increased in radar: Radar could be used to detect enemy aircraft, so the military began using Doppler radar during World War II. Continuous-broadcast radar was initially developed during World War II to assist in night combat operations.

- Radar was also used to aim searchlights, aim anti-aircraft guns, guide ships, locate enemy ships, and direct gunfire during World War II.
- The first Doppler radar sets had large analog filters that made them heavy and bulky.

- During the 1970s, modern microprocessors enabled radar use for weather forecasting and air traffic control.
- When digital technology was developed, specialized radar devices became lighter and less expensive.

The Doppler Effect

The Doppler effect is defined as the difference between an observed frequency and the emitted frequency of a wave for an observer moving relative to the source of the waves. The Doppler effect was named after physicist Christian Doppler, who proposed it.

- The variation in frequency depends on the direction in which the wave source is moving.

Doppler Weather Radar (Weather Surveillance Radar)

Next-Generation Radar, or NEXRAD, is also known as the U.S. Weather Surveillance Radar network. This weather station network includes roughly 160 S-band radar sites throughout the United States that provide general weather information.

- Many other countries also use weather surveillance radar.

How Weather Radar Works

NEXRAD gathers information about precipitation and wind using returned energy. When a radar device emits a burst of energy and it collides with an object, such as a drop of rain or a snowflake, the energy scatters in all directions. A small fraction of the energy bounces back toward the radar device.

- The weather station network can update weather information every five to six minutes.
- Slow scanning rates can reduce the weather surveillance radar's ability to detect tornadoes and microbursts of wind.

Weather Forecasting

The Doppler effect provides meteorologists with information about the positions of targets and the way they are moving. With a positive phase or Doppler shift, the target is moving toward the radar, and a negative Doppler shift shows that the target is moving away from the radar.

- Dual-polarized radar is a newer type of radar being used to predict weather. Instead of just emitting and receiving horizontal pulses, dual polarization enables transmission and reception of vertical pulses, too.
- Dual polarization makes it possible to differentiate between different types of precipitation, such as rain, snow, and hail.

Additional Resources

- Using and Understanding Doppler Weather Radar
- Weather Radar Explained
- How Does Radar Work?
- Radar Fundamentals
- How to Use and Interpret Doppler Weather Radar
- Weather Radar: How Does it Work?
- Weather Radar Fundamentals
- Radar Principles and Systems
- Weather Radar
- HF Radar Principles of Operation
- How Does Radar Work?
- Radar Basics: Types and Applications
- Radar Basics

- Radar Principles
- Understanding Weather Radar
- How Does Weather Radar Work?
- How to Read Weather Radar Like a Pro
- What Is a Weather Radar, and How Does it Work?
- How Do Weather Radars Work?
- What Is Doppler Radar, and How Does it Work?
- Doppler Radar Explained
- How Does Weather Radar Work?
- Doppler Radar
- How Radar Works
- The Basics of Weather Radar
- Overview of Radar History
- What Is Weather Radar? The Ultimate Guide
- How to Effectively Use Weather Radar
- This Month in Physics History
- History of Radar
- Overview of the History of Radar
- Understanding the History of Radar
- How Radar Changed the Second World War
- Radar: A New Invention
- Radar During World War II
- When Radar Came to Town
- Radar: The Battle-Winner?
- Brief History of Radar Technology
- Radar During World War II
- A Brief History of Weather Radar