

Θέμα 9^ο

Navigation II

Pre-reading Activity

Match the terms on the left with their definitions on the right.

1. relay	a. A brief temporary change in a normally constant quantity, e.g. in a voltage, or a series of intermittent disturbances that are regular in form and frequency of occurrence.
2. reflect	b. To pass on, transmit.
3. radarscope	c. To send back.
4. pulse	d. The oscilloscope viewing screen of a radar receiver.

1.	2.	3.	4.
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Reading 1 (ΜΕΤΑΦΡΑΣΗ)

Read the text below and check your answers.

Radar Basics

Radar is actually an acronym that stands for Radio Detection And Ranging. It was developed in the early 1940s. Radar uses the **echo** principle. Radar equipment **emits** a high energy radio signal from an antenna. The signal travels out from the source until it is **reflected** back by contact with an object. The radar antenna **relays** this signal to a scope where the image is displayed. Using the time it takes for the emitted signal to reach the object and reflect back to its source, the distance to the object can be computed. The radar signal is moving at the speed of light and can make such a trip in microseconds.

“Radar is actually an acronym that stands for Radio Detection And Ranging.”

In aviation, a ground radar antenna sends radio signal **pulses** into the sky. These signals are reflected back by aircraft flying in the airspace. The **radarscope** displays the direction and distance from which the signals are reflected back. This coupled with each aircraft's transponder signal identifies the aircraft on the radarscope. Also, all airliners are equipped with radar equipment in the aircraft's nose. Short bursts of radio signals are emitted from the nose cone of the aircraft. These signals reflect off clouds ahead of the aircraft. The on-board computer calculates the distance and displays

the object (the cloud) on the on-board radar screen.

In general, the radar provides information on range, azimuth¹, and/or **elevation** of objects. If only range and azimuth information is available, it is a 2-D radar and if information about the elevation is also available, then it is a 3-D radar.

A primary radar is one that uses reflected radio signals, while in a secondary radar system (see *the Reading text in Section Two*) a radio signal **transmitted** from a radar station initiates the transmission of a radio signal from another station.



📍 A MiG-35 Nose Radar



📍 An ATC Radarscope



📍 An ATC Radar Antenna

¹ The horizontal angle to an object, measured clockwise from a fixed reference point, usually north or south.

Reading Activity – Comprehension Questions

Read the text again and answer the following questions.

1. What does the acronym “radar” stand for?
2. On what principle is radar based?
3. What is the radarscope used for?
4. What information does a 2-D radar provide?
5. What is a primary radar?

Word Study

Read the text again and choose the appropriate words in bold that best complete the sentences below.

1. One way to measure the distance to an object is to a short pulse of radio signal (electromagnetic radiation), and measure the time it takes for the reflection to return.
2. Conventional air surveillance radar measures the location of a target in two dimensions-range and azimuth. The angle, from which target height can be derived, also can be determined. That is what a “3-D” radar does.
3. A radar system has a transmitter that radio waves. When they come into contact with an object they are scattered in all directions. The signal is thus partly reflected back and it has a slight change of wavelength (and thus frequency) if the target is moving.
4. In basic radar, radio waves are transmitted from an antenna. These outgoing waves eventually bounce off some distant object and return an to the sender, where they are received, amplified, and processed electronically to yield an image showing the object’s location.
5. The metal body of an airplane is very good at radar signals, and this makes it easy to find and track airplanes with radar equipment.

Pre-reading Activity

Read the text of Reading 1 again and decide whether the following statements are **true** (T) or **false** (F).

1. The military uses radar to map the Earth and other planets and to track satellites and space debris.
2. NASA uses radar to detect the enemy and to guide weapons.
3. Meteorologists use radar to track storms, hurricanes and tornados.
4. Air Traffic Control (ATC) uses radar to track aircraft both on the ground and in the air and also to guide them in for smooth landings.
5. Police use radar to detect the speed of vehicles.

Reading 2 (ΜΕΤΑΦΡΑΣΗ)

Read the text below and check your answers.

How Radar Works

Radar is something that is in use all around us, although it is normally invisible. Air traffic control uses radar to **track** planes both on the ground and in the air, and also to guide planes in for smooth landings. Police use radar to detect the speed of passing motorists. NASA² uses radar to map the Earth and other planets, to track satellites and **space debris** and to help with things like docking and maneuvering. The military uses it to detect the enemy and to guide weapons. Meteorologists use radar to track storms, hurricanes and tornadoes. Obviously, radar is an extremely useful technology. When people use radar, they are usually trying to accomplish one of three things:

“Air traffic control uses radar to track planes both on the ground and in the air, and also to guide planes in for smooth landings.”

a) Detect the presence of an object at a distance - Usually the “something” is moving, like an airplane, but radar can also be used to detect stationary objects buried underground. In some cases, radar can identify an object as

well; for example, it can identify the type of aircraft it has detected.

b) Detect the speed of an object - This is the reason why police use radar.

c) Map something - The space shuttle and orbiting satellites use something called Synthetic Aperture Radar to create detailed topographic maps of the surface of planets and moons.

All three of these activities can be accomplished using two things you may be familiar with from everyday life: echo and **Doppler shift** (or Doppler Effect). These two concepts are easy to

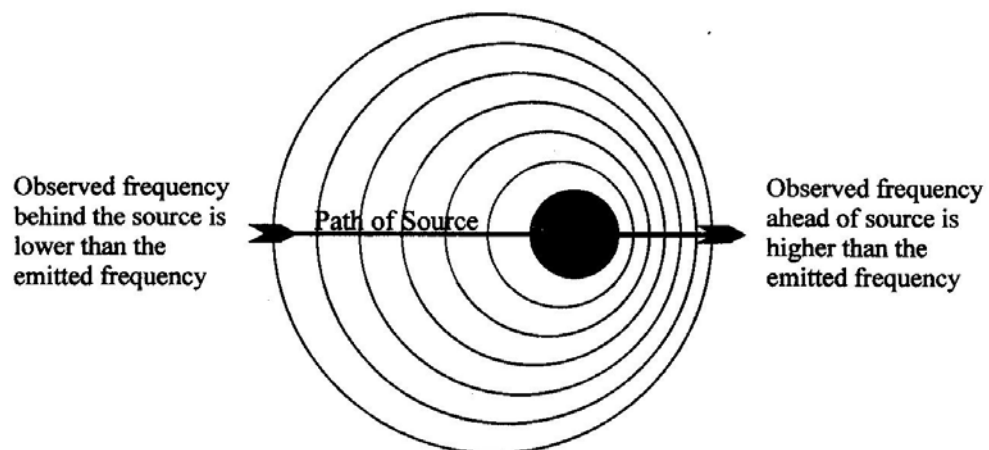
² National Aeronautics and Space Administration.

understand in the realm of sound because your ears hear echo and Doppler shift every day. Radar makes use of the same techniques by means of radio waves.

Echo and Doppler Shift

Echo is something you experience all the time. When you shout into a well, for example, the sound of your shout travels down the well and is reflected (echoes) off the surface of the water at the bottom of the well. If you measure the time it takes for the echo to return and if you know the speed of sound, you can calculate the depth of the well fairly accurately.

Doppler shift is also common. It occurs when sound is generated by, or reflected off of, a moving object. Let's say for instance there is a car coming toward you at 60 miles per hour (mph) and its horn is blaring. You will hear the horn playing one "note" as the car approaches, but when the car passes you the sound of the horn will suddenly shift to a lower note. It's the same horn making the same sound the whole time. The change you hear is caused by Doppler shift. In other words, it is the change in frequency that happens to sounds when they are moving closer or farther relative to a listener. To sum up, when a vehicle sounding a siren or horn approaches, passes, and **recedes** from an observer, the received frequency is higher (compared to the emitted frequency) during the approach, it is **identical** at the instant of passing by, and it is lower during the **recession**³.



The Doppler Shift (or Doppler Effect)

³ The action of moving away from an observer.

Reading Activity – Comprehension Questions

Read the text again and answer the following questions.

1. Can you name at least three uses of radar?
2. What is echo?
3. On which concepts does radar operate?

Word Study

Read the text again and choose the appropriate words in bold that best complete the sentences below.

1. Scientists warn that the growing amount of orbiting the Earth threatens the safety of human and robotic space missions.
2. According to Doppler weather radar theory, which studies the frequency of waves in the air, to ascertain the movement and direction of wind and to forecast weather, when the source of the waves approaches the observer (or radar), the frequency of the waves increases, while during, the frequency of the waves decreases.
3. The primary weather surveillance radar system operated by U.S. agencies is the NEXRAD (Next-Generation Radar) system, consisting of about 150 nearly radars.
4. One concept that is very important for radars is that of The main idea here is that, depending on how fast a target is moving, it will actually change the frequency of the radar's transmitted wave when it reflects it.

Vocabulary Review 1 – Description of Primary (Pulse) Radar

Fill in the gaps of the following text using the words from the list below.

transmitted	object	detect	quadruple
range	higher	frequencies	reflected

Primary (pulse) radar works on the 1. signal principle. When transmitted electromagnetic radio energy encounters an 2., it is reflected back to the point from which it was originally 3.; therefore, it is used to 4. aircraft. It

does not require any specific equipment in the aircraft. Primary radar uses ultrahigh and very high 5. that have minimal static and atmospheric attenuation, and it uses a line-of-sight propagation path. Primary radar is also known as pulse radar and reflective radar. There are some factors that can affect the 6. capabilities of a primary radar system, such as atmospheric attenuation (a), antenna power (b), and the height of the aircraft (c).

a) Atmospheric attenuation: It reduces the range of a primary radar system. The greater the atmospheric attenuation, the more power is required to achieve the same range.

b) Antenna power: The greater the power output of the antenna, the greater is the range of the transmitted radio energy. To double the range, you have to 7. the power.

c) Height of the aircraft: Because of the curvature of the air, the 8. the aircraft, the greater is the distance at which it can be detected by radar.

Vocabulary Review 2 – Military Aircraft, Stealth

Fill in the gaps of the following text using the words from the list below.

transparent	electronic warfare	avoid	missions	coatings
penetration	transmitter	conventional	aerospace	precision-guided
perform	signals	curved	absorb	reflected

Military aircraft make use of the very latest in 1. technology. Advanced manufacturing techniques and materials are employed to give the best possible performance. The main goals are to produce a tough and reliable aircraft which can 2. its designated role, while carrying the latest weapons. For instance, stealth aircraft are designed to 3. radar by absorbing or deflecting signals so that they are not 4. back to the radar 5. To do this, the body and wings are smoothly 6. so the signals bounce off to the side. Where possible, materials 7. to radar signals, like composite plastics, are used, and other surfaces are treated with radar-absorbing 8. Special attention is paid to the position of the engines, because the rapidly rotating fan blades normally reflect radar 9. efficiently. The engines are set well back into the wing or body structure, with long inlet and exhaust ducts to diffuse and 10. radar signals. Stealth technology provides its users with a number of tactical advantages. As well as allowing the 11. of heavily defended airspace, it enables single aircraft to carry out attacks in a manner impossible for 12. aircraft, which require a large number of support aircraft to conduct similar 13., including escort, defense suppression, and 14. types. A conventional aircraft "package" may employ up to 40 aircraft, while a stealth aircraft can conduct the mission by itself. This naturally requires the use of 15. weapons to ensure that the single aircraft has a high probability of success. However, stealth is not without its drawbacks. The cost of the technology is enormous, and it is hard to envisage that its eventual employment in maritime and land operations will ever be obtained at a price comparable to conventional technology.

