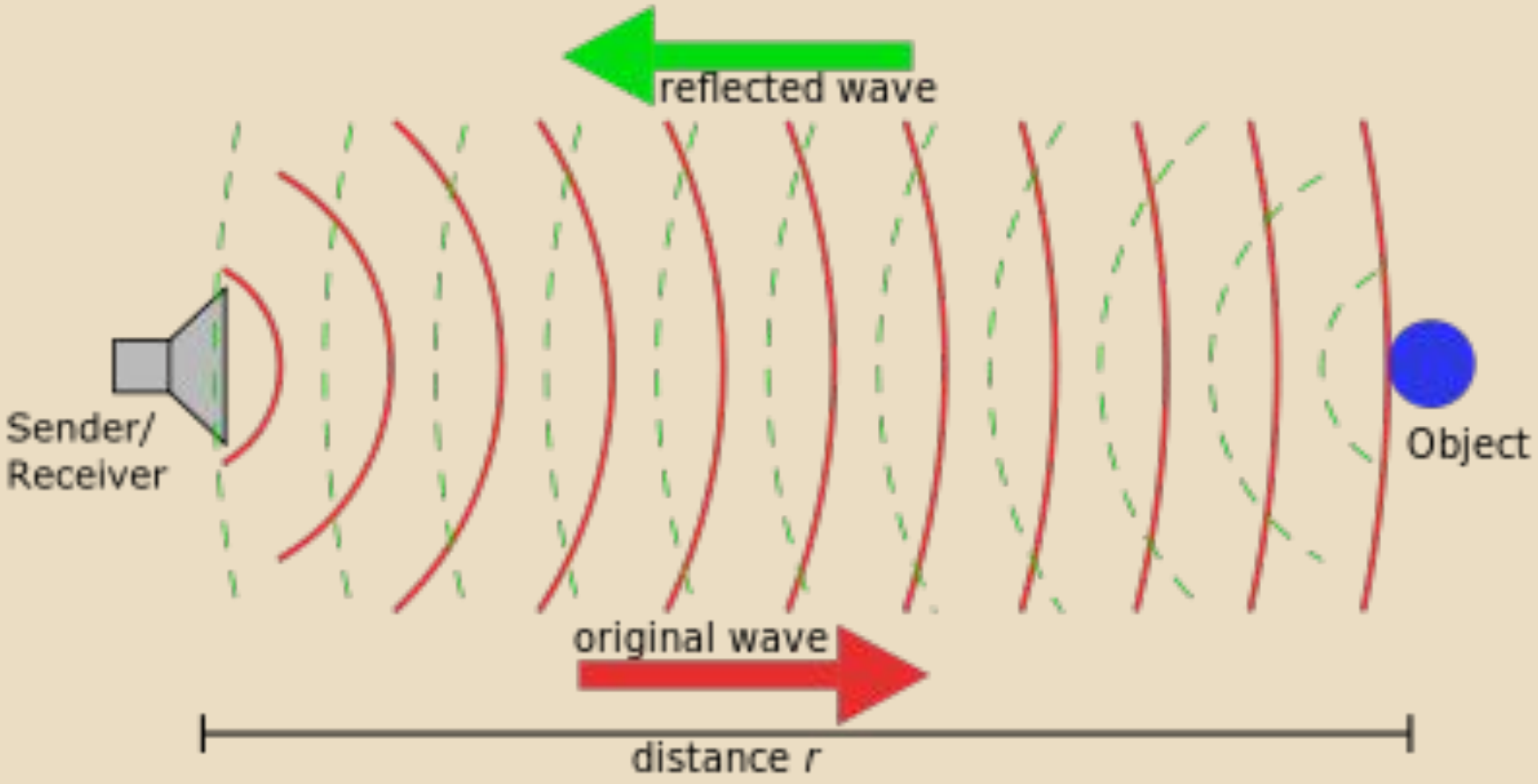
Applications of Ultrasonic

Ultrasound Identification (USID)



Conti…

- Ultrasound Identification (USID) is a Real-Time Locating System (RTLS) or Indoor Positioning System (IPS) technology used to automatically track and identify the location of objects in real time using simple, inexpensive nodes (badges/tags) attached to or embedded in objects and devices, which then transmit an ultrasound signal to communicate their location to microphone sensors.

Non-contact sensor

- An ultrasonic level or sensing system requires no contact with the target. For many processes in the medical, pharmaceutical, military and general industries this is an advantage over inline sensors that may contaminate the liquids inside a vessel or tube or that may be clogged by the product.
- Both continuous wave and pulsed systems are used. The principle behind a pulsed-ultrasonic technology is that the transmit signal consists of short bursts of ultrasonic energy. After each burst, the electronics looks for a return signal within a small window of time corresponding to the time it takes for the energy to pass through the vessel. Only a signal received during this window will qualify for additional signal processing.

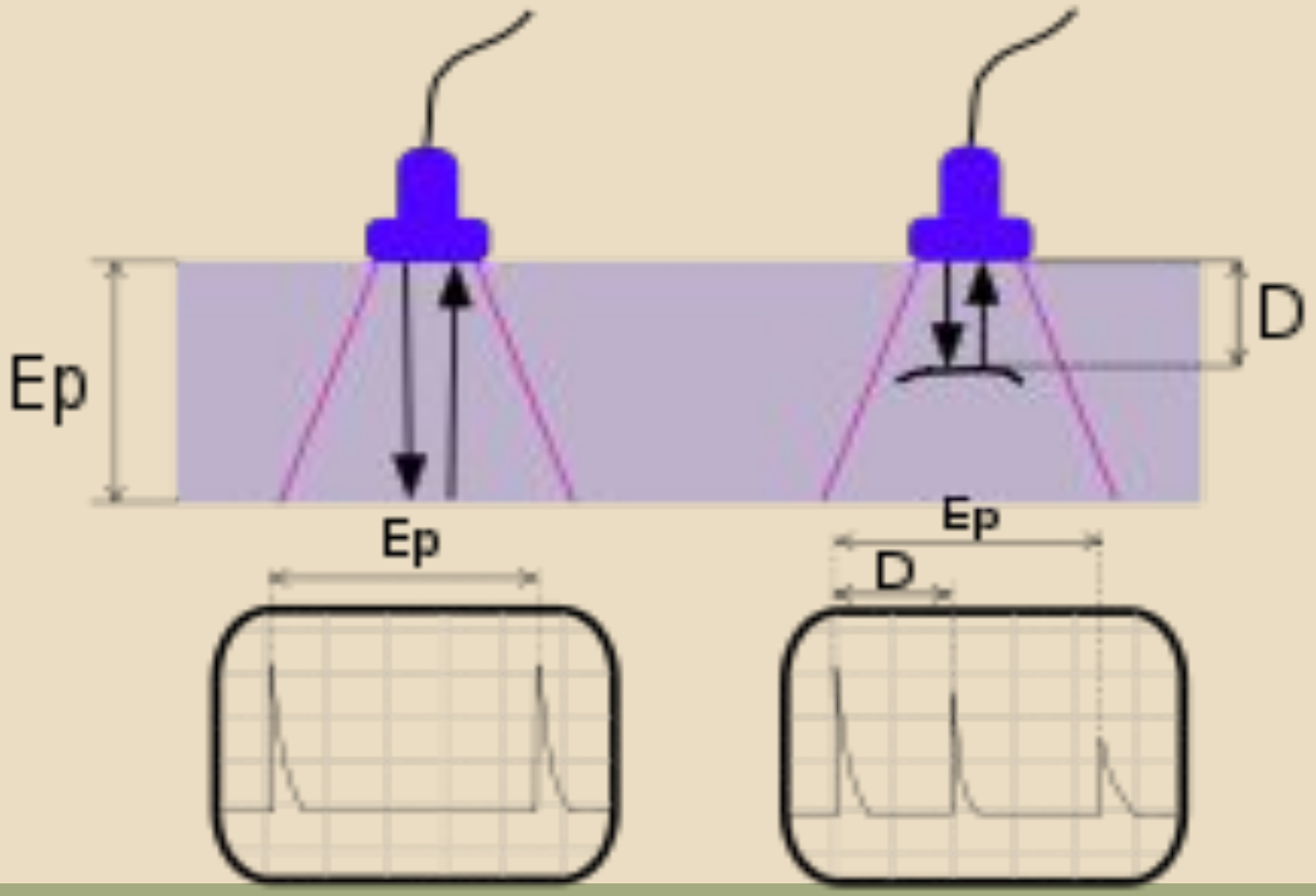
Motion sensors and flow measurement

- A common ultrasound application is an automatic door opener, where an ultrasonic sensor detects a person's approach and opens the door. Ultrasonic sensors are also used to detect intruders; the ultrasound can cover a wide area from a single point. The flow in pipes or open channels can be measured by ultrasonic flowmeters, which measure the average velocity of flowing liquid.

Nondestructive testing

Ultrasonic testing is a type of nondestructive testing commonly used to find flaws in materials and to measure the thickness of objects. Frequencies of 2 to 10 MHz are common, but for special purposes other frequencies are used. Inspection may be manual or automated and is an essential part of modern manufacturing processes. Most metals can be inspected as well as plastics and aerospace composites. Lower frequency ultrasound (50–500 kHz) can also be used to inspect less dense materials such as wood, concrete and cement.

Nondestructive testing ....Conti...



Ultrasonic range finding

- A common use of ultrasound is in underwater range finding; this use is also called Sonar. An ultrasonic pulse is generated in a particular direction. If there is an object in the path of this pulse, part or all of the pulse will be reflected back to the transmitter as an echo and can be detected through the receiver path. By measuring the difference in time between the pulse being transmitted and the echo being received, it is possible to determine the distance.

Imaging

- Ultrasonic imaging uses frequencies of 2 megahertz and higher; the shorter wavelength allows resolution of small internal details in structures and tissues. The power density is generally less than 1 watt per square centimetre to avoid heating and cavitation effects in the object under examination. High and ultra high ultrasound waves are used in acoustic microscopy, with frequencies up to 4 gigahertz. Ultrasonic imaging applications include industrial nondestructive testing, quality control and medical uses.
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Human medicine

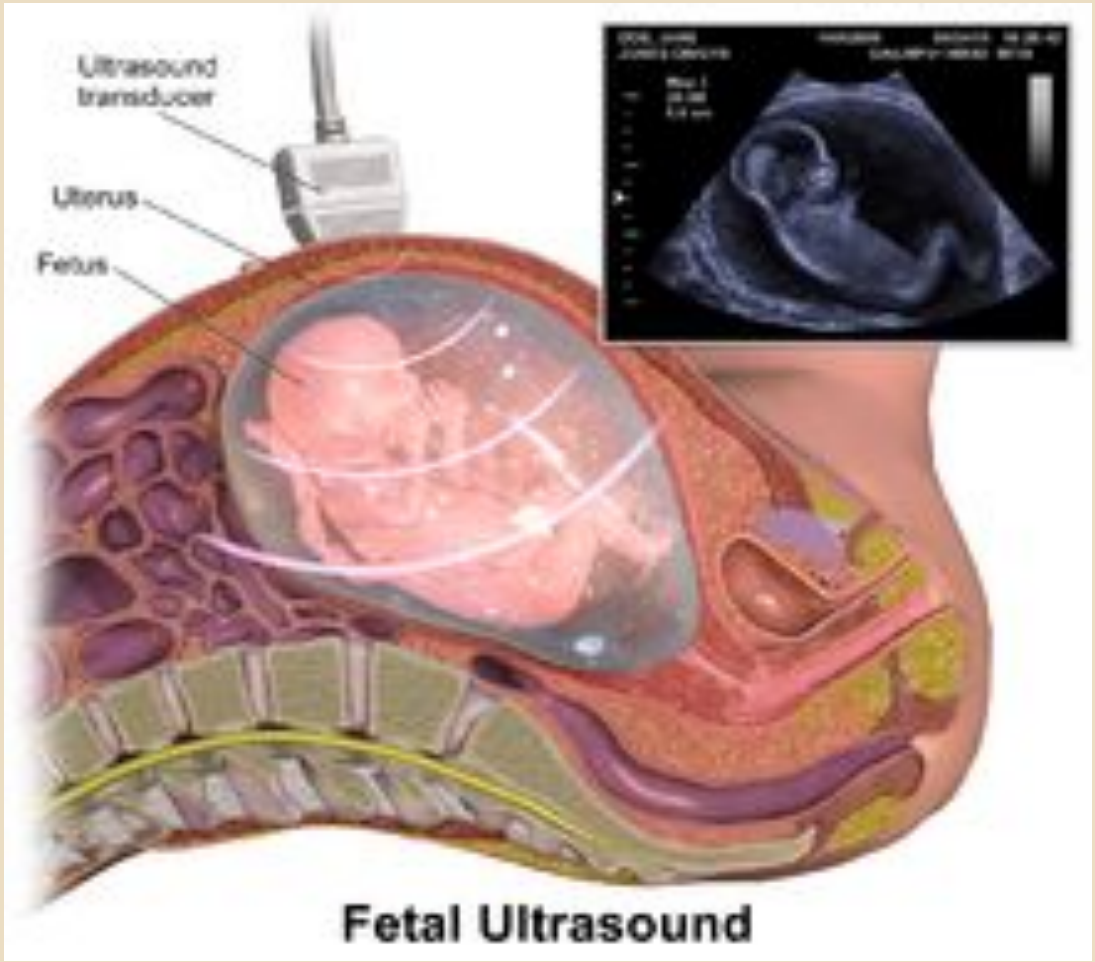
More Applications

- **Biomedical applications**
- **Ultrasonic impact treatment**
- **Processing of water purification**
- **Ultrasonic cleaning**
- **Ultrasonic humidifier-**The ultrasonic humidifier, one type of nebulizer
- **Ultrasonic welding**

Weapons

- Ultrasound has been studied as a basis for sonic weapons, for applications such as riot control, disorientation of attackers, up to lethal levels of sound.

Fetal ultrasound



Animals

- Bats use ultrasounds to navigate in the darkness.

Animals.....

- Dogs and cats' hearing range extends into the ultrasound; the top end of a dog's hearing range is about 45 kHz, while a cat's is 64 kHz. The wild ancestors of cats and dogs evolved this higher hearing range to hear high-frequency sounds made by their preferred prey, small rodents. A dog whistle is a whistle that emits ultrasound, used for training and calling dogs. The frequency of most dog whistles is within the range of 23 to 54 kHz.

SONAR

contents

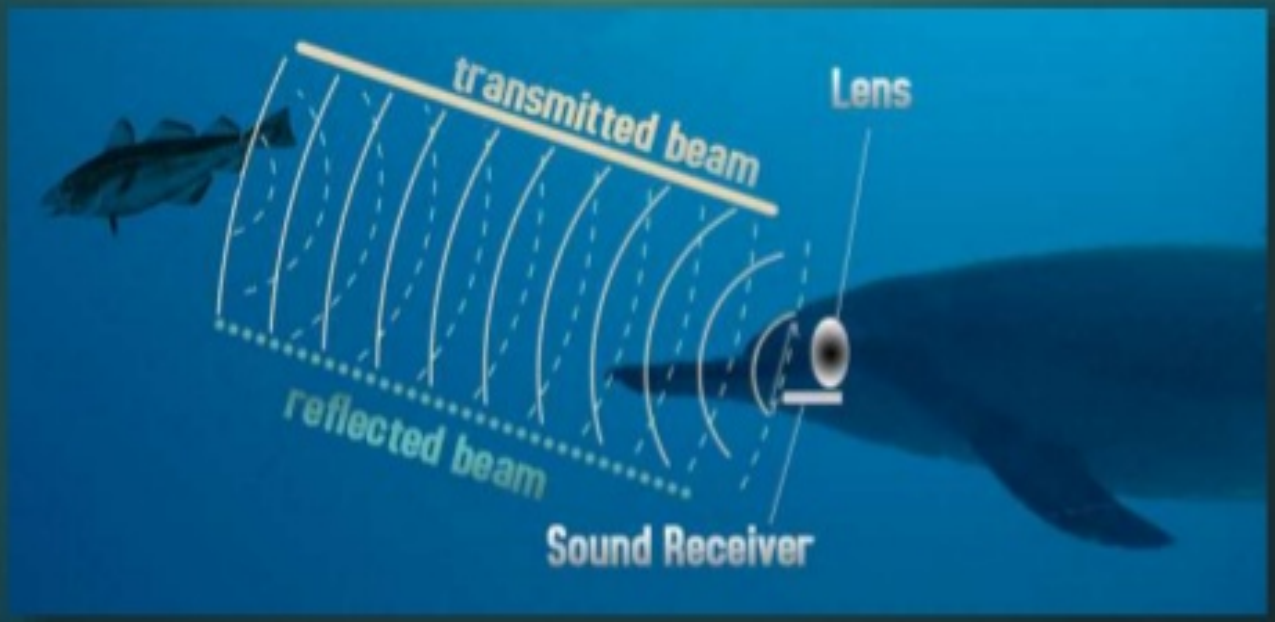
- Introduction
- History of sonar
- Sonar technology
- Active sonar
- Passive sonar
- Performance factor
- Application
- limitation

introduction

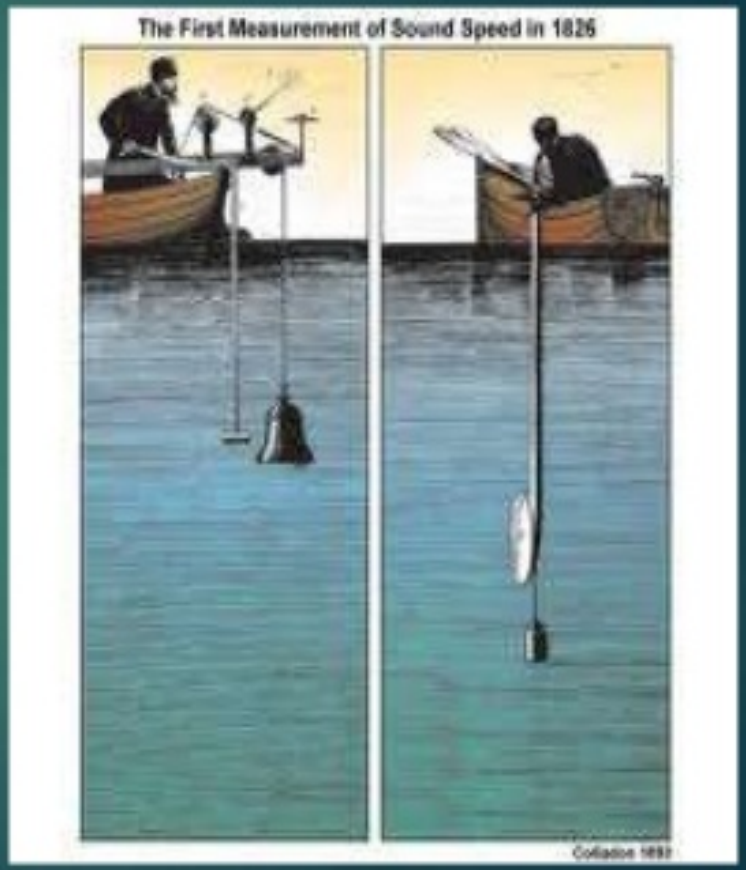
- Sonar ,which in itself originally an acronym for Sound Navigation And Ranging.
- It is a method of detecting , locating ,and determining the speed of objects through the use of reflected sound waves .
- A system using transmitted and reflected underwater sound waves to detect and locate submerged objects
- The acoustic frequencies used in sonar systems vary from very low (infrasonic) to extremely high (ultrasonic).

history

- We know that some animals (dolphins and bats) have use sound as a medium of communication and objects detection for millions of years

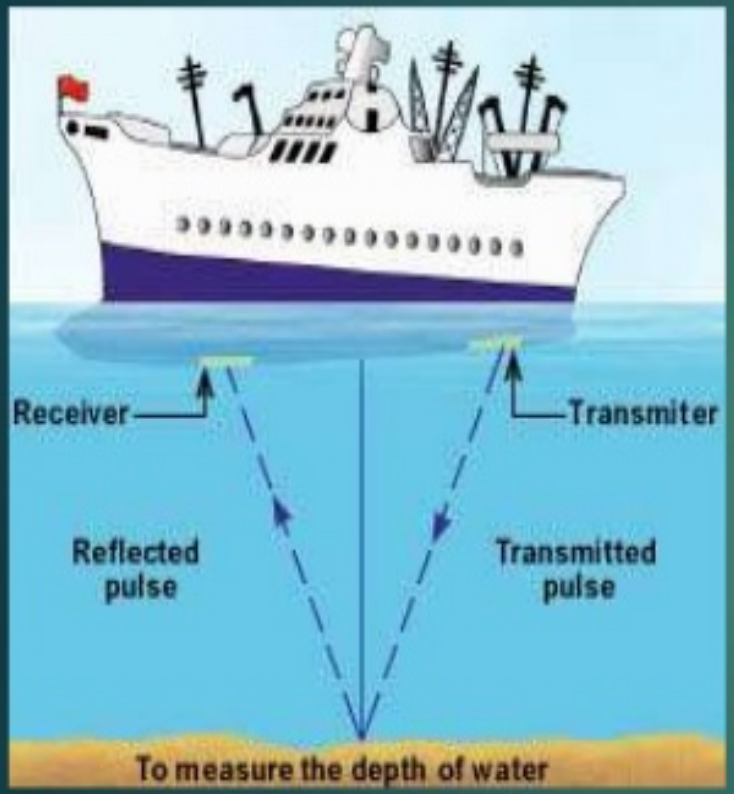


- But use of the sound by humans in the water is initially recorded by Leonardo da Vinci in 1490: a tube inserted into the water was said to be used to detect vessels by placing an ear to the tube.
- Sonar was first patented by Lewis Richardson and German physicist Alexander Behm in 1913.



Sonar

- Sonar is a device that is used to detect underwater objects using sound waves.
- In this system a sound pulse is generated and sent underwater through a transmitter.
- sound waves are reflected by the underwater object which are received at receiver.
- The time taken by sound wave to come back is recorded.
- And by knowing the speed of sound wave in water the distance can be easily calculated by formula.
- Distance = speed x time


Receiver
Transmiter
Reflected pulse
Transmitted pulse
To measure the depth of water

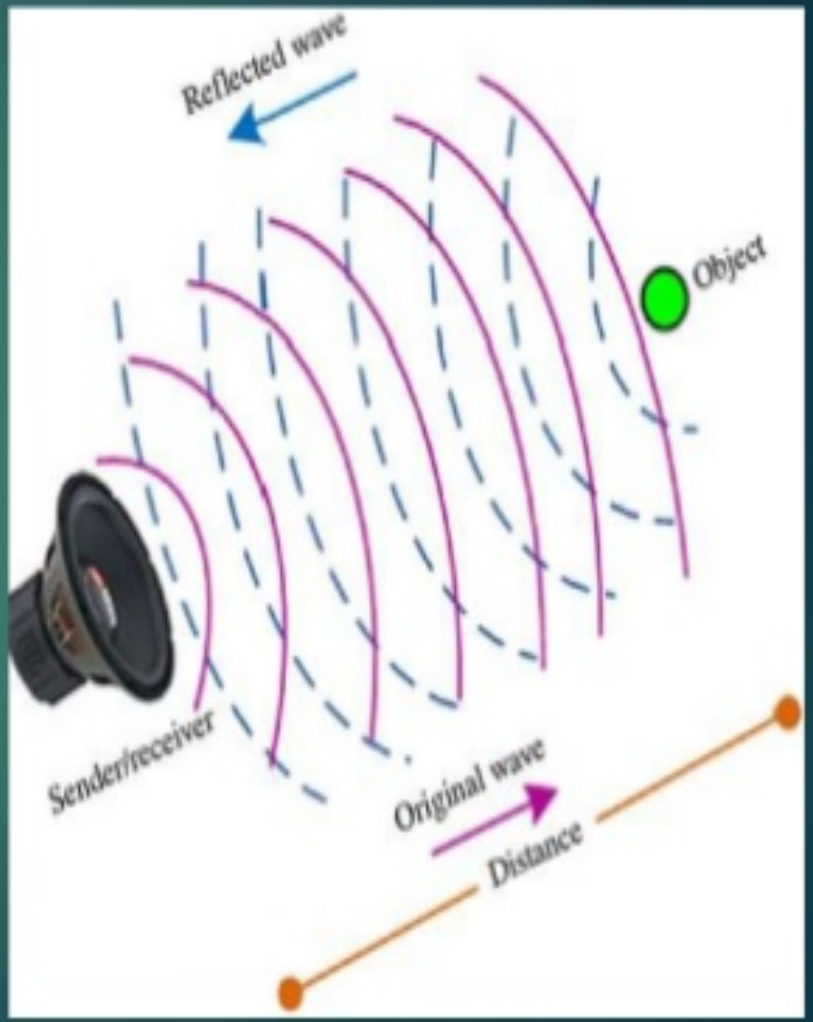
Type of sonar

sonar is of two types:

- Active sonar
- Passive sonar

Active sonar

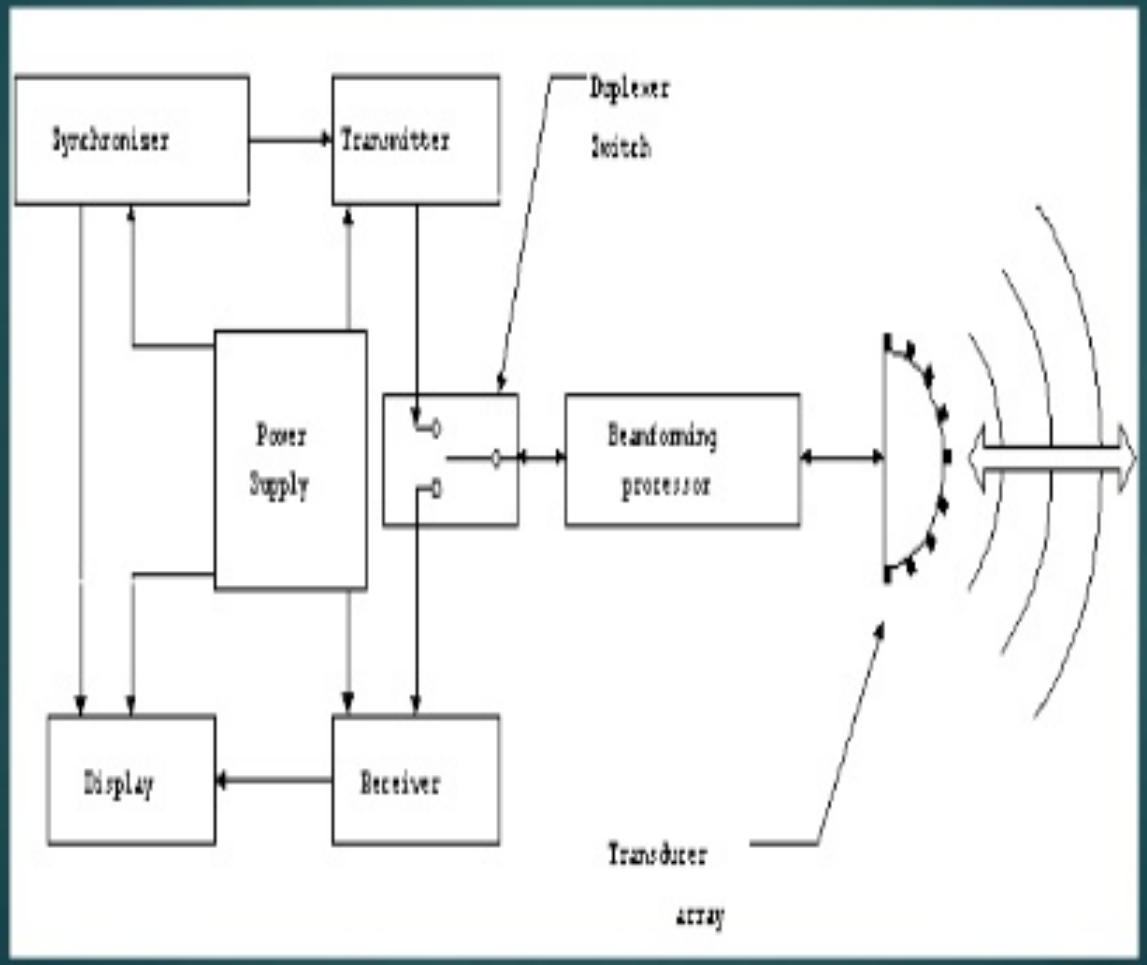
- Active sonar uses sound transmitter and receiver . And there are 3 modes of operation :
- Monostatic mode
- Bistatic mode
- Multistatic mode



- Monostatic mode : when the transmitter and receiver are at the same place.
- Bistatic mode : when the transmitter and receiver are separated by some distance.
- Multistatic mode : When more transmitters (or more receivers) are used, again spatially separated.

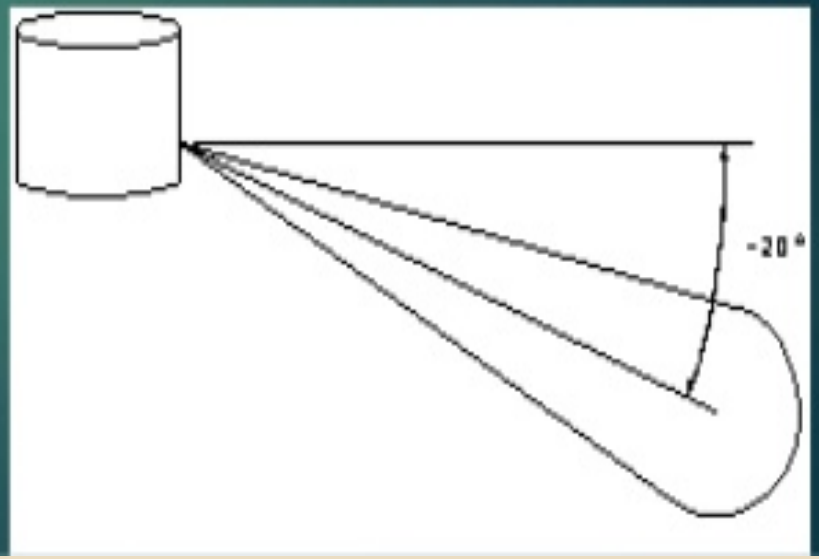
- Most sonars are used monostatically with the same array often being used for transmission and reception.
- Active sonar creates a pulse of sound, often called a "ping", and then listens for reflections (echo) of the pulse.
- This pulse of sound is generally created electronically using a sonar projector consisting of a signal generator, power amplifier and electro-acoustic transducer/array.
- To measure the distance to an object, the time from transmission of a pulse to reception is measured and converted into a range by knowing the speed of sound.
- To measure the bearing, several hydrophones are used, and the set measures the relative arrival time to each.

Block diagram of an active sonar



Functional components

- Transmitter : The transmitter generates the outgoing pulse. It determines pulse width,pulse reception frequency, modulation and carrier frequency.
- Transducer array : The individual transducers are simple elements with little or no directionality. They are arranged in an array to improve the directivity index, which improves the figure-of-merit by noise reduction.
- The array of transducers reduces the beamwidth in the horizontal direction, and is usually circular in order to give more or less complete coverage



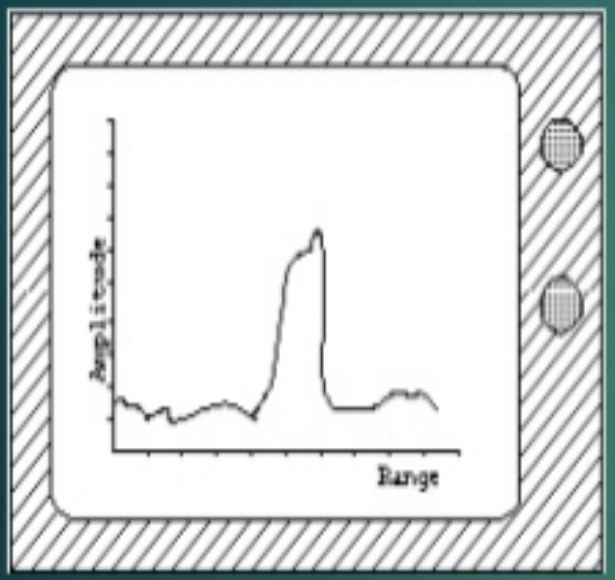
Vertical beam of typical transducer array.

- Duplexer switch : it is a switch that toggles between transmitter and receiver.
- Syncroniser : Provides overall coordination and timing for the system. Reset the display for each new pulse in order to make range measurements.
- Receiver : Collects the received energy. The receiver may also demodulate the return if frequency modulation is used on transmission

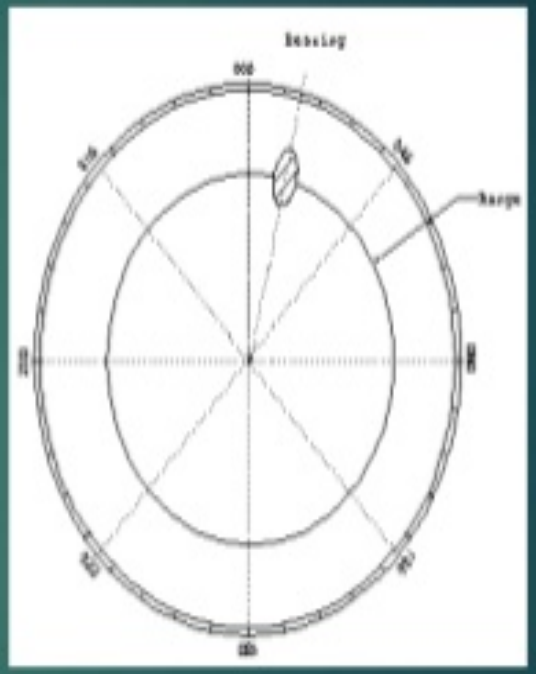
- Display : Puts all of the detection information into a visual format. There are several types:

- A-scan : the signal along a single beam for a portion of the listening cycle. A target appears as a raised section if it is in the beam.

- PPI(plan position indicator) : A top-down (geographic view). The sonar system must sequentially search individual beams which are displayed in their true or relative form. The strength of the retum is represented by the intensity on the display.

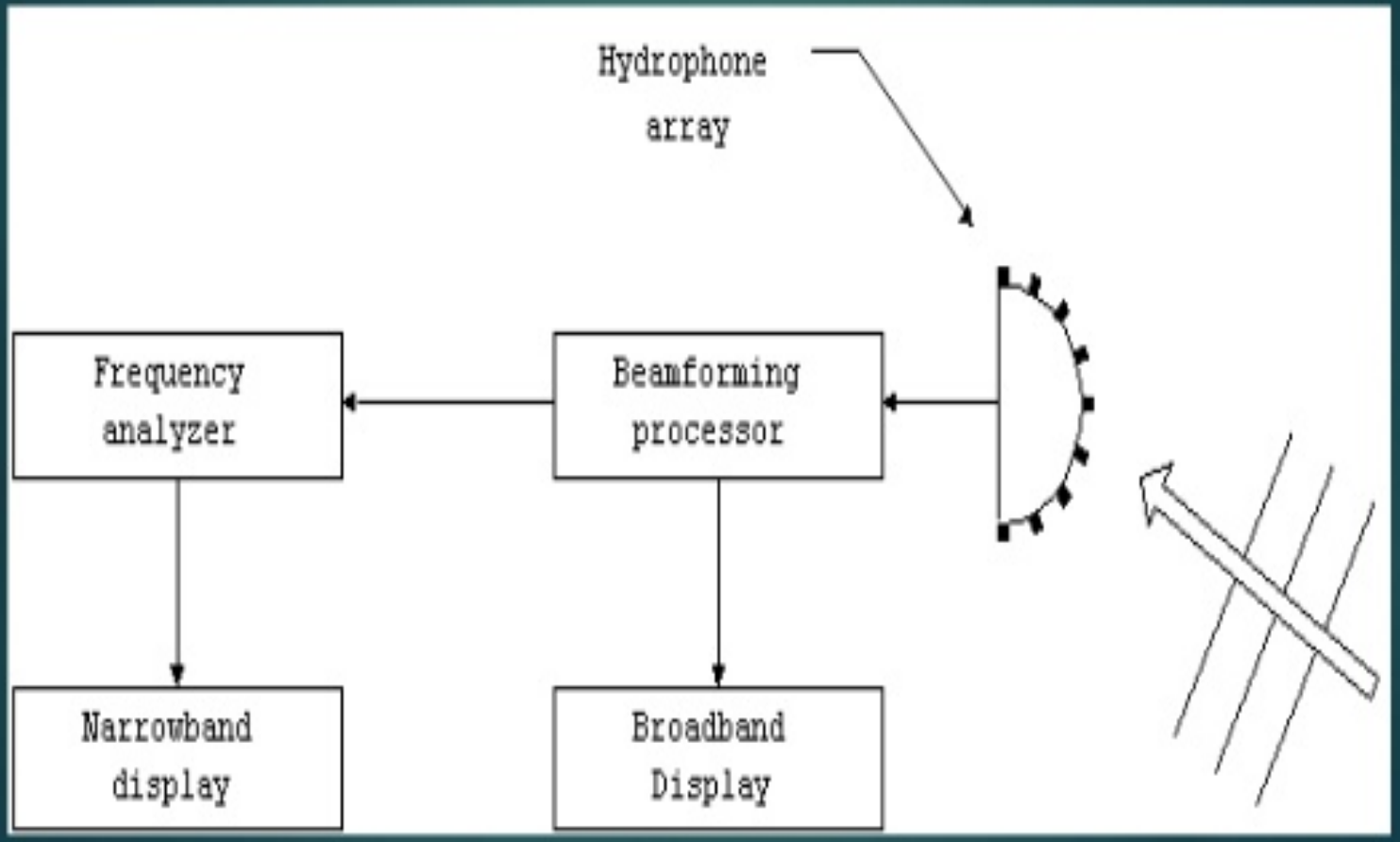


A – scan display



PPI display

Block diagram of passive sonar



application

- It is used to find the actual depth of the sea.
- Sonar systems are used to find lost ships and submarines.
- These are used in ocean surveillance systems.
- They are used by navy detect the locations of enemy submarines.
- They are used for under water security.

limitation

- It has an adverse effects on marine animals like dolphins and whales ,that also use sound waves for their navigation.
- It leads whales to painful and often fatal decompression sickness.
- The sonar systems generate lot of noise
- High intensity sonar sounds can create a small temporary shift in the hearing threshold of some fish


Thank you!