The Variety Between Sound Waves, Ultrasonic Waves, Subsonic Waves & Light Waves.

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ABSTRACTION

In this paper, we're going to differentiate between the Sound, Ultrasonic, Subsonic, and light waves.

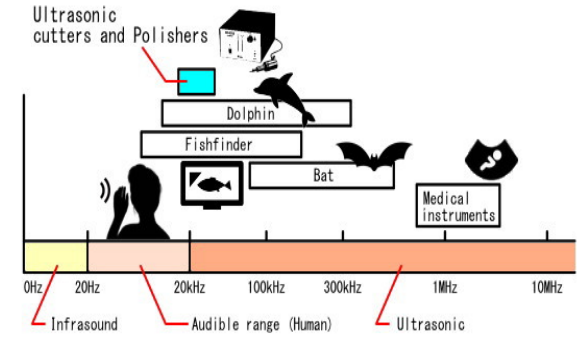
INTRODUCTION

Sound waves are longitudinal mechanical waves that need medium to travel through, in the other hand light waves are transverse electromagnetic waves which can travel in space. Ultrasonic waves and subsonic waves are just a sound waves with some varieties in frequency bands and speed that would be declared in the following sections.

LONGITUDINAL & TRANSVERSE WAVES

Waves are one of the ways in which energy may be transferred between stores. Waves can be described as oscillations, or vibrations about a rest position. For example:

- sound waves cause air particles to vibrate back and forth.
- ripples cause water particles to vibrate up and down.



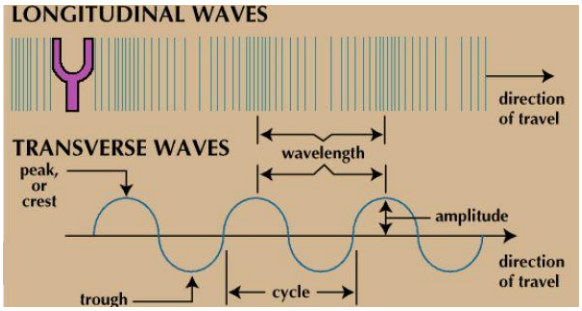


Figure 1 Longitudinal waves and Transverse waves.

The direction of these oscillations is the

Figure 2 Frequency bands of sound

difference between longitudinal or transverse waves. In longitudinal waves, the vibrations are parallel to the direction of wave travel. In

transverse waves, the vibrations are at right angles to the direction of wave travel.

SOUND WAVES

As mentioned before sound waves are longitudinal mechanical waves that needs a medium to travel through be oscillating that medium's particles. The audible frequency range of sound wave is [20Hz-20KHz] as you can see in figure 2. Sound waves are longitudinal waves, they need a medium to travel through. By causing particles of the medium to vibrate parallel to the direction of wave travel. So, sound cannot travel through a vacuum because there are no particles to carry the vibrations.

ULTRASONIC WAVES

Ultrasonic or ultrasound waves are just a sound waves with frequencies higher than the upper audible limit of human hearing. Ultrasound is not different from "normal" sound in its physical properties, except that humans cannot hear it. This limit varies from person to person and is approximately 20 kilohertz in healthy young adults.

SUBSONIC WAVES

A subsonic wave is a wave that is traveling slower than the speed of sound and a supersonic wave travels faster. By definition, a sound wave travels at the speed of sound which varies depending on the medium through which it's traveling.

$$v_{sound\ in\ air} \approx 331.4 + 0.6T_C \ \ m/s$$

LIGHT WAVES.

Scientists have discovered that light travels in both waves and as tiny particles called photons. In both wave and particle (photon) form, light is energy. Light waves travel in straight paths called rays. Unlike sound, where waves must travel through matter to be heard, light waves do not have to travel through matter to be seen. Instead, rays travel in a straight path until they hit an object. A ray's straight path is the path of light. Parallel rays grouped together represent a beam of light.

The propagation of electromagnetic waves either in a certain medium or in vacuum is due the mutual changes between the electric and magnetic field. Referring to the four maxwell's equation and from the wave equations of the electric and magnetic fields, anyone can conclude that the spatial variation of the electric field is always accompanied with a time varying of the magnetic field and hat the spatial variation of the magnetic field is always accompanied with a time varying of the electric field. These variations in electric and magnetic fields lead to the transfer of the energy which is carried by the EM wave. Therefore, EM waves will constantly propagate with non-stopping until meet a barrier.

$$\nabla \cdot \mathbf{D} = \rho$$
$$\nabla \cdot \mathbf{B} = 0$$
$$\nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t}$$
$$\nabla \times \mathbf{H} = \mathbf{J} + \frac{\partial \mathbf{D}}{\partial t}$$

Figure 3 Maxwell's Equations

CONCLOSION

Sound Waves are longitudinal mechanical waves that travels by oscillating the mediums' particles, so sound waves can't travel in vacuum. Also, ultrasonic waves are just a sound waves with higher frequency

range (> 20KHz), and subsonic waves also are a sound waves with speed less than the normal sound wave in 0 ^{0}C temperature.

But in the other hand light waves are transverse Electromagnetic waves that can travel in the space or vacuum due to the mutual changes in the electric and magnetic fields.

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