

Wave Motion in a Medium for Sound and Light

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Abstract

Expressions are obtained for the wavelength and frequency of a sound wave in air and a light wave in space, emitted from a source moving with speed u , relative to an observer moving with speed v . The speed w of sound in air as a gas, depending on the temperature, pressure and density of the gas, is taken to be independent of speed of the source. The speed c of light in space, depending on the permittivity and permeability of the space, is taken to be a constant relative to the source. The product of frequency and wavelength of a wave motion in a medium is considered a constant, equal to the speed of the wave motion for an observer stationary relative to the source. While air is the medium for propagation of sound, electric fields, from bodies in space, are proposed as the medium for propagation of light in the space. It is suggested that electric fields from neutral bodies, consisting of equal numbers of positive and negative charges, do exist in space but they balance out exactly at every point. In this case, aether is conceived as a sea or crisscross of electric fields from neutral bodies, balancing out exactly everywhere in space and reducing to zero at infinitely long distances from the respective sources, in accordance with Coulomb's law. Electric permittivity and magnetic permeability should be regarded as properties of electric fields in space, constituting the aether. Beyond the aether is a vacuum extending to infinity. A vacuum has no property.

Keywords: Aether; Air; Doppler Effect; Electric Field; Frequency; Light; Space; Velocity; Wavelength

Introduction

The velocity of sound wave, emitted by a source in air or water as the medium of propagation, is taken to be independent of velocity of the source. In the case of air, the velocity depends on pressure and density at a given temperature. Where the moving source of sound overtakes the wave front, sonic boom is heard, but there is no such a phenomenon for light.

This paper does not subscribe to the principle of constancy of speed of light, according to the theory of special relativity [1,2]. The speed of light c , as determined by JC Maxwell [3], is taken to be a constant relative to the source. In other words, light takes on the speed of its source. This speed can be added to, or subtracted from, by speed of the observer. Aberration of light, discovered by English Astronomer, James Bradley, in 1728 [4], could not have been possible if the speed of light were a constant for all moving observers. Doppler Effect, described by the

Austrian physicist, Christian Doppler, in 1842 [5], in sound, is accepted as due to the relativity of speed of sound with respect to a moving observer. Such relativity is not acceptable, by special relativity, for a light wave.

Air, obviously, is the medium of propagation of sound. In the case of light, what is the medium of propagation? Electric fields, emanating from bodies or matter, are proposed as constituting the medium for propagation of light in space. Space is supposed to be a sea, network, grid or crisscross of electric fields from matter, providing a medium, called aether, for gravitation and propagation of light with a constant speed.

In this paper, the wavelength λ and frequency f of a wave motion in air or free space, propagated at a speed, are determined. It is assumed that the product λf is a constant equal to the stationary value $\lambda_0 f_0$. This product is equal to the speed w for sound or speed c for light, in a wave from a source that is stationary with respect to an observer or where the source and the observer are moving with the same velocity.

Sound Wave in Air

The speed w of sound, in air at a given temperature, at pressure P and density ρ is:

$$w = \sqrt{\frac{\gamma P}{\rho}} \quad (1)$$

where γ is the ratio of specific heats (1.4 for air). This is independent of speed of the source.

Relative velocity \mathbf{r} between a sound wave propagated with velocity \mathbf{w} in air and the source moving with velocity \mathbf{u} , is vector:

$$\mathbf{r} = \mathbf{w} - \mathbf{u} \quad (2)$$

Relative velocity \mathbf{s} between a sound wave propagated with velocity \mathbf{w} in air and an observer moving with velocity \mathbf{v} , is vector:

$$\mathbf{s} = \mathbf{w} - \mathbf{v} \quad (3)$$

Equations (2) and (3) change the wavelength from λ_0 to λ and the frequency from f_0 to f , so that:

$$\lambda = \frac{\mathbf{w} - \mathbf{u}}{\mathbf{w} - \mathbf{v}} \lambda_0 \quad (4)$$

The frequency becomes:

$$f = \frac{\mathbf{w} - \mathbf{v}}{\mathbf{w} - \mathbf{u}} f_0 \quad (5)$$

where \mathbf{u} , \mathbf{v} , and \mathbf{w} are vectors in any direction and the quotient of two vector quantities may be a scalar quantity. If the vectors are collinear, we get the wavelength λ and the frequency f in terms of the scalar speeds u , v , and w , as:

$$\lambda = \frac{w - u}{w - v} \lambda_0 \quad (6)$$

$$f = \frac{w - v}{w - u} f_0 \quad (7)$$

Equations (6) and (7) explain Doppler Effect in sound. Sonic boom, zero wavelength and infinite frequency, happen where $w = u$. An infinitely large wavelength and zero frequency occur if $w = v$, in which case no sound is heard.

Light Wave in the Aether

The speed of light c , in space, as determined by JC Maxwell [3], is given by:

$$c = \sqrt{\frac{1}{\mu_0 \epsilon_0}} \quad (8)$$

where μ_0 is the magnetic permeability and ϵ_0 the electric permittivity of space. This is a constant relative to the source. Velocity of light \mathbf{c} , relative to a source moving with velocity \mathbf{u} , is vector:

$$\mathbf{y} = \mathbf{c} \quad (9)$$

Velocity of light from a source moving with velocity \mathbf{u} , relative to an observer moving with velocity \mathbf{v} , is vector \mathbf{z} , given by:

$$\mathbf{z} = \mathbf{c} + (\mathbf{u} - \mathbf{v}) \quad (10)$$

Equations (9) and (10) change the wavelength from λ_0 to λ and the frequency from f_0 to f so that:

$$\lambda = \frac{\mathbf{c}}{\mathbf{c} + (\mathbf{u} - \mathbf{v})} \lambda_0 \quad (11)$$

$$f = \frac{\mathbf{c} + (\mathbf{u} - \mathbf{v})}{\mathbf{c}} f_0 \quad (12)$$

where \mathbf{c} , \mathbf{u} and \mathbf{v} are vectors in any direction. If the vectors are collinear, we get the wavelength λ and the frequency f in terms of scalar speeds c , u and v , as:

$$\lambda = \frac{c}{c + (u - v)} \lambda_o \quad (13)$$

$$f = \frac{c + (u - v)}{c} f_o \quad (14)$$

Equations (13) and (14) explain Doppler Effect or Doppler Shift in light. If the source and the observer move in the same direction and at the same speed, there is no change in wavelength or frequency. There is a decrease in wavelength, and a corresponding increase in frequency (blue shift), if the source of light moves towards the observer or if the observer moves towards the source. The frequency is doubled for a source of light moving towards a stationary observer, or an observer moving towards a stationary source, at the speed of light. There is an increase in wavelength, and a decrease in frequency (red shift), if the source of light moves away from the observer or if the observer moves away from the source. A source of light moving away, from a stationary observer, at the speed of light c , becomes invisible.

Aether as the Medium for Propagation of Light in Space

Empty space is considered to be of infinite expanse, consisting of isolated regions of matter or bodies, from which electric fields emanate in accordance with Coulomb's law. Electric fields from neutral bodies do exist in space. The electric fields, crisscrossing space, balancing or cancelling out exactly everywhere, constitute what is commonly termed aether. Magnetic permeability μ_o and electric permittivity ϵ_o should be regarded as properties of the aether. The electric fields vanish at infinitely long distances from their respective sources. Beyond the aether, and extending to infinity, is empty space, a vacuum, that has no property.

The electric fields from bodies, crisscrossing space, balancing out exactly everywhere and vanishing at infinite distances from the respective sources, constitute the aether. Oscillation of an electric charge and its electric field, in a body or in space, gives rise to an electromagnetic wave, transmitted along the field and perpendicular to the direction of oscillation of the field. The wave is transmitted along the electric field with speed of light c as given by Maxwell's equation (equation

8). A number of electric fields as vectors \mathbf{E}_i constituting the aether, cancelling or balancing out exactly everywhere, may be expressed as a zero-sum:

$$\mathbf{E} = (-1)^i \sum_{i=1}^N \mathbf{E}_i = 0 \quad (13)$$

where $i = 1, 2, 3, \dots, N$. But the square of each field remains positive and the squares add up to account for the pressure, mass density and energy density of the aether. The energy per unit volume or energy density ν of the aether is:

$$\nu = \frac{\epsilon_o}{2} \sum_{i=1}^N \mathbf{E}_i^2 = \frac{\rho}{2\mu_o\epsilon_o} = \frac{P}{2} \quad (14)$$

where ρ is the mass density and P the pressure of the aether, that which we do not become aware of. An analogous situation obtains with the Earth's atmosphere, where the energy density, equal to the balanced air pressure (76 cm of Hg or 14.7 lb/in² or 10.1 N/cm² or 10.1 pascal at sea-level) is not normally perceived by our bodies or senses.

A Cause of Inertia

A particle of charge Q , moving at time t with velocity \mathbf{v} , relative to an observer, carries along its electrostatic field \mathbf{E}_o and transverse magnetic field, given by vector cross product as $\mathbf{H} = \epsilon_o \mathbf{v} \times \mathbf{E}_o$, without any distortion, as there is nothing to resist its motion. Where there is acceleration or an oscillation, a reactive electric field \mathbf{E}_a is produced in a direction opposite that of acceleration $d\mathbf{v}/dt$, such that the Poynting vector $\mathbf{E}_a \times \mathbf{H}$ [6] gives the direction of energy intensity and propagation of the wave, which is along the electrostatic field. The author [7] proposed that \mathbf{E}_a acts on the same charge producing it to create the inertial force \mathbf{F} as:

$$\mathbf{F} = Q\mathbf{E}_a = -m \frac{d\mathbf{v}}{dt} \quad (14)$$

This gives an idea of the cause of inertia, a body's resistance to acceleration or deceleration.

Results and Discussion

Doppler Effect in sound and in light are clearly explained as due to the relativity of speed of sound in air or speed of light in space, from a moving source, with

respect to a moving observer. This is accepted for sound but rejected in favour of the theory of special relativity.

Proposition of the aether as an ocean or crisscross of electric fields in space, constituting a medium for gravitation and propagation of light, should put into question the notion of four-dimensional space-time continuum of the theory of general relativity.

Doppler Red Shift, interpreted as indicating an expanding universe, very far away from the Earth, may be a local phenomenon on the Earth, due to decrease in speed of a light wave as it suffers refraction on passing through the atmosphere. This should cause a decrease in speed of light and decrease in frequency of a light wave, reaching the Earth. It could have the apparent appearance of objects receding from the Earth, as reported by Edwin Hubble in 1929 [8] but it does not explain Hubble-Lemaitre law in modern cosmology, where the speed of expansion (from the Big Bang) is supposed to be proportional to distance from the source. However, the recessional speed should not be beyond the speed of light c .

Conclusion

Sound wave and light wave, or any wave motion, need a physical medium for transmission. For a sound wave, the air is obviously the medium of propagation. For a light wave, it is the aether, a medium composed of electric fields, from bodies in space, emanating in accordance with Coulomb's law.

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