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"Sound Resonance and Wave Properties in Gases and Liquids Investigating the Nature of Soundwaves Formula Extension"

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I. Background And Rationale:

Our research is an attempt to derive mathematical formula to describe the state of a system created by to or more waves resulting in a shockwave production
The shockwave produced is a carrier of an energy that can be used for motion in gases and liquids
To be able to utilize this energy we must be able to describe the state of a system of two or more waves at any given time thus deriving a formula that links energy produced to the component characteristics of the wave e.g frequency amplitude etc

A mathematical model is used which presents a system of waves as a sum or difference of two vectors which is the resulting vector or a shockwave It is a model that has been obtained after using detailed analysis of both longitudinal and transverse waves

The purpose of my research is to make a phenomenon such as interference of waves to be studied as a means of creating of energy that can be utilized for the purposes of engineering physics research and mathematical description

My research is called "Sound resonance and wave Properties in Gases and liquids Investigating the nature of soundwaves "

The subject of my research were chosen acoustic waves and on their example I'd like to demonstrate the characteristics of a shockwave as a main carrier of an energy and transmitter of it in different kinds of environment

Lets start with a stepwise analysis of what a resonance is and how that very phenomenon can help us resolve one of the main problems e.g a carrier of the energy

Before I get to the main part of my work I'd like to do a little of incourse into what was behind my research in the first place

While looking at the nature of waves one can not but notice that waves are different by the way they are created For example soundwaves can be characterized as longitudinal although we can generate them by means of using generators the active area of which vibrates according to transversal principle Thus formulas describing the vibrations of the surface area of sound generations and the formulas describing longitudinal waves can be different and conversion should apply When we look at the transversal waves we describe their behavior as sine waves whereas longitudinal waves can be presented as a logarithmic or exponential function What we are interested in here is the nature of the resulting wave that is created by the interference of the two waves (or more) and how is this wave a shockwave that is can be characterized as a carrier of energy

To simplify the description we are going to look at the waves purely as a carrier of an energy that can further be utilized for different purposes and from that standpoint its easier to regard our waves and a resulting shockwave as a vector I am going to try and explain it from the point of view of mathematics

Lets take a look at the sum (difference) of the two vectors The resulting sum (difference) vector is our sought shockwave which in itself is a carrier of energy

Here is the way to write it in polar coordinate form:
$k(sinx+cosx)$
Seems like this formula doesn’t give us much feedback as to how the shockwave is the carrier of the energy yet lets try and expand it :
k is a unit vector multiplied by $(sinx+cosx)$ lets raise the sum $k(sinx+cosx)$ to the n power We will get

(1.1) $\left(k^2(sinx+cosx)^2\right)^{\frac{n}{2}} = k^n*((x-1)^2)^n = k^n\sum_{r=o}^{\frac{n}{2}}\frac{\frac{n}{2}!}{r!\left(\frac{n}{2}-r\right)!}\left(\sin 2x\right)^{\frac{n}{2}-r}$ *: /* $\frac{n!}{r!(n-r)!}$ is number of

combinations $\binom{n}{r}$

Of course $\left(k^n(sinx-cosx)^2\right)^{\frac{n}{2}} = k^n((1-2sin2x)^2)^{\frac{n}{2}}$ but it is also a series which depends on the coefficient

k^n *(* k is the vector*)*
The proof of our hypothesis about addition of scalars can be easily derived from Pythagorean equation
$x^2+y^2=1$
From where

($(k^2*((x-1)^2))^{\frac{n}{2}}$: | is our sum of vectors presented in the form of the product of k
and $(x-1)$
Our $(x-1) = (sinx-1)$
For instance our function

(1.2) $f(x) = k^n*2^n\sum_{r=0}^{n}\sin 2x^r = k^n2^n(\frac{1-(\sin 2x)^{n+1}}{1-\sin 2x})$
Thus allowing us to define it at a given interval
Here one must mention that the sum of sin function represent the resulting constructive and destructive interference of waves In the real life when two waves collide their resulting energy is zero as the constructive-destructive interferences compensate themselves In the lab conditions we can adjust angles of waves and direction so that the interference will be constructive and as such we will have a positive outcome of energy
Below I present my stepwise description to make you familiar with the way I came to the conclusion to present a shockwave as a carrier of energy

Let’s take a look at the physics interpretation of resonance
The reason why we consider shockwaves as the object of our investigation is by means of studying them to better explain the nature of accoustic waves and their interaction A solid chunk of experiments
have been conducted to study the properties of shockwaves yet there's no enough theoretical calculations that will clearly explain the relation between
the nature of the shockwaves their behavior and difference in behavior in liquids and gases and how the classic Newtonian laws govern the processes that
are physical by nature Another important aspect is the form that the waves are converted from one type into another In our case this is been achieved by converting
formulas describing transversal into longitudinal It's purely a mathematical relation yet when we translate it into the language of Lagrangean mechanics we can see that all
formulas stand and they apply for creating of the shockwaves The phenomena of a shockwave can be described as a process of energy conversion
Which is a very important point as by realising and utilization of this process we will be able to use this very energy to propell objects in liquids and gases
Our current investigation is performed on the molecular level and thus is easy to describe by means of simple relations and equations
Though the same very principle can be used on atomic and subatomic level and for studying of other types of waves as energy

medium and behavior of it's components (molecules atom electrons etc) thus we can predict the behavior of a system applying theoretical calculations
See "Experimental methods of shockwave research" Ozer Igra Friedrich Seiler
We also use the Lagrange formulas when we refer to energy conversion formulas See S.Widnall 16.07 Fall 2009 "Energy Methods: Lagrange's Equations"

II. Summary:

The aforementioned project is in acoustics and the properties of the acoustic waves So far the attempts to make sound waves a propelling power for the objects of big mass and volume were not successful due to the lack of theoretical substantiation which is what my project is aimed to fulfill It's an attempt to make a conversion from transversal to longitudinal wave formula as accoustic waves are longitudinal and the vibrations of the sound generators creating these waves are transversal (we use sound generators to produce acoustic waves that will interact creating a state described as a shockwave) It's important to convert formulas that describe transversal into longitudinal which is done by exponentiation of the (sin) function This is done to describe the state of the two waves at the moment of "collision" so we have exponential function on one side and exponential on the other Let's call it *B(x)* and *B1(x)* after they collide the resulting state of a system is *0* provided that before the impact it was different from *0* so *B(x)-B1(x)=0* where *B(x)=B1(x)* There are a lot of physical phenomenas constructive interference destructive shockwave creating etc It all requires physics lab research to be able to generalize it further That is what my research is aimed A few more words on the subject Suppose after impact the state of a system is different to what it was before it The aim is to match the values of *B(x)* and *B1(x)* to the state they were before We can 'adjust' the system B(x) to the previous state by changing it's frequency amplitude and displacement we can do it by means of registering the data before and after the impact and we can also linearize the data and know how the system will behave It comes to the point where we must create multiple shockwaves that would impact the body to make it move the formula that will describe the *B(x)* and *B1(x)* in that particular environment(gas or liquid) under certain conditions will be the desired result And from here there will be many other possible solutions Both generators can be described by the type of waves they produce In our case transversal meaning that the active area of each generator vibrates according to the formula *P(x)+C* for the first generator and *P1(x)+C1* for the second
The next step is linearization of the function *P(x)+C* and *P1(x)+C1* which is our exponential functions $arcsinCe^{P(x)}$ and $arcsinC1e^{P1(x)}$
What did we do it for? So that we can find the state of a system at a given t when the shockwave is created The shockwave in itself is a longitudinal wave and thus can not be described by the same formula that describes transversal or sine waves That was the purpose of linearizing formulas *P(x)+C* and *P1(x)+C1*
The state of a system after the impact is *0*

By the Lagrangean law
$$mv^2 / 2 = -mgh$$
We can factor out m only to see that for us important is the system of gas or liquid and not the weight or the shape of an object
Now after the impact the summative state of a system (by the system we mean generators of sound and the air or the liquid in which the shockwave is produced) changed
It was $P(x) + C + P1(x) + C1 = arcsinCe^{P(x)} + arcsinC1e^{P1(x)}$
and now is zero
whatever the nature of the waves is we can present them as a product of a constant and a function e.g as a state of a system at the moment when the shockwave is created
Even more so we can substitute a constant by a strength of the wave :S
$$Se^{P(x)} + S1e^{P1(x)}$$
and for us from now on only the state of the system at the moment when the shockwave is created will be important
Remember that x is actually a t -time so we have a function of a time which is originally any exponential function: $P(x) = P0(x)^{rt}$
Thus we have proved that the state of a shockwave is an exponential function of time
I have much easier way of presenting the same concept using maths yet I would like you to pay attention to the fact that by means of soundwaves it's possible to create an energy to lift or move objects in a liquid or gas
I am going to skip some details now and move to a technical part
Physics

We have managed to create a shockwave once Now our system turns back to the state where kinetic energy is 0 whereas before it was equal the energy of a shockwave
What do we do now?
By the rate of change of the vector product we can assess the state of a system with reference of $t\ ds/dt$ which will give us the speed of the particles(molecules of gas or liquid) at any given time We do not need to go any further as the total sum of energy emmitted will be $\sum mv^2$
Total mass of a gas or a liquid remains constant

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