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Physical Meaning of Euclidean Approach to the Problems of Relativity

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Abstract

INTRODUCTION: In this paper, we discuss the fundamental problem of the relationship between the true and observed shapes of reality.

OBJECTIIVES: Considered is the problem if, is the Minkowksi space-time the model of the “true” reality or is the Minkowski model of the reality a result of existence certain mysterious structure of the reality which is simpler than the Minkowski space-time but for some reason it is observed as the Minkowski space-time.

METHODS: As a solution to this problem, a novel approach is proposed, where the time and space dimensions are not the “true” dimensions creating reality, but are merely certain directions in a four-dimensional Euclidean reality, and these directions are not stable but depend on the observation of a pair – an observer and an observed body. In other words, an observer for observing various bodies needs to choose each time a different set of directions interpreted by him as the dimensions of time and space. According to the new model of reality, relativistic effects are the result of a change in the angle of mutual inclination between directions (in four-dimensional Euclidean reality) interpreted by an observer as the dimensions of space and time of his coordinate system in four-dimensional Euclidean reality, instead of deformation of dimensions of space time, as is currently assumed in the Minkowski model.

RESULTS: Such a model provides a much simpler description of reality at the cost of a more complicated manner of observation. It also allows the connection of the relative motion with the absolute space, allows the description of a particle directly as a wave in E4 (not as a mysterious wave function), and explains the Hubble law and Mach principle. Almost all the results of the new approach are identical to those obtained from the Minkowski model; however, a few of them allow us to draw conclusions different from those predicted by the Theory of Relativity, which can be a reliable test for the correctness of the new approach.

CONCLUSIONS: The new idea of reality deeply changes our understanding of reality not only in the range of the Theory of Relativity but also because of the description of particles directly as waves of E4 - also of Quantum Mechanics

1. Introduction

“One of the main problems of special relativity is whether there exists a physical four dimensional space-time or are space and time different entities for which Minkowski space is a convenient coordinate system.” This was the first sentence in the Introduction of Alexander Gersten’s article published in 2003 [1]. He et others [2-7] tried to solve this problem by describing relativistic phenomena with the help of alternative Euclidean coordinate systems, which are much simpler than those in Minkowski space-time. However, these studies did not produce a complete model better than the current TR shape. However, I would like to pay attention to A. Gersten’s paper because one of the ideas presented here enables us to examine the problems of describing reality from a new point of view. This is the idea of so-called "mixed spaces, which relies on a simple rewriting of the space-time interval equation.

If the space-time interval is written in the form:

$$s_{12}^2 = c^2(\Delta t)^2 - (\Delta r)^2 = c^2(\Delta t')^2 - (\Delta r')^2 \tag{1}$$

Where
$$(\Delta r)^2 = (\Delta x)^2 + (\Delta y)^2 + (\Delta z)^2 \tag{2}$$

Thus, (1) can be rewritten in the following form, which is equivalent to (1).

$$m_{12}^2 = c^2(\Delta t)^2 + (\Delta r')^2 = c^2(\Delta t')^2 + (\Delta r)^2 \tag{3}$$

In (3) the invariant s_{12}^2 is replaced by the other invariant – m_{12}^2, however the spaces created by coordinates ct,r' and ct,' r (3) -called by the author the "mixed spaces" - are Euclidean and the transition from one such coordinate system to the another is a simple SO(4) rotation, at some angle α in the Euclidean space, which can be expressed in the form:

$$\begin{pmatrix} x' \\ y' \\ z' \\ ct \end{pmatrix} = \begin{pmatrix} cos\alpha & 0 & 0 & sin\alpha \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ -sin\alpha & 0 & 0 & cos\alpha \end{pmatrix} \begin{pmatrix} x \\ y \\ z \\ ct' \end{pmatrix} \tag{4}$$

Then he finds that the angle α describes the relative velocity:

$$sin\alpha = -\frac{v}{c} \tag{5}$$

And:

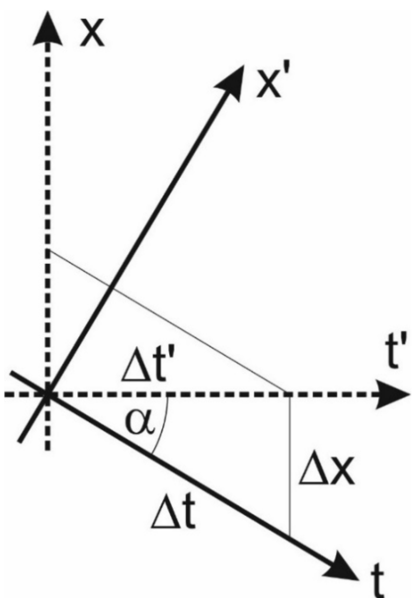
$$cos\alpha = \sqrt{1 - \frac{v^2}{c^2}} \tag{6}$$

Finally, he derived the Lorentz transformation:

$$\begin{pmatrix} x' \\ y' \\ z' \\ ct' \end{pmatrix} = \begin{pmatrix} \left(1 - \frac{v^2}{c^2}\right)^{-\frac{1}{2}} & 0 & 0 & -vc\left(1 - \frac{v^2}{c^2}\right)^{-\frac{1}{2}} \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ -vc\left(1 - \frac{v^2}{c^2}\right)^{-\frac{1}{2}} & 0 & 0 & \left(1 - \frac{v^2}{c^2}\right)^{-\frac{1}{2}} \end{pmatrix} \begin{pmatrix} x \\ y \\ z \\ ct \end{pmatrix} \tag{7}$$

This is the derivation of the Lorentz transformation done with the help of Euclidean "mixed spaces" where the Lorentz transformation is the result of SO(4) rotation at the angle α connected with the relative velocity by formula (5). It was derived from equation (3), which is equivalent to equation (1). Thus, the result is identical to that derived from equation (1).

2.Two alternative derivations of transformation of coordinates



to

However, in the above-mentioned derivation, Gersten applied tools that were originally designed for the non-isotropic Minkowski space. While he defined the equivalent tool based on the Euclidean space, where instead of deformation dimensions, we can apply a simple rotation of coordinate systems in Euclidean space, it is also possible apply much simpler tools for solving relativistic problems, where we can take advantage of the isotropy of Euclidean geometry. If in (1) defining the s_{12}^2 invariant was necessary to obtain the dependence between the coordinates of the moving coordinate systems (because the Minkowski space is not isometric), then in the case of the Euclidean space, the definition of the invariant m_{12}^2 in (3) is not necessary. This m_{12}^2 invariant is the distance in Euclidean space, and

SO(4) rotation is isometric; therefore, it conserves this distance by definition.

Additionally, Gersten's proof derived for SO(4) rotation is the derivation for SO(2) rotation. Therefore, the above derivation can be reduced to a simple problem on the plane where we can draw axes and angles and then derive the Lorentz transformation from a simple geometric dependence known by grammar school pupils.

Fig.1 Axes of two "mixed spaces" coordinate systems drawn on a plane representing the Euclidean "mixed spaces" space. From this figure instantly results – the definition of the velocity (5,8) and the relation between the times in both systems described with the use of formula (6,9)

While equations (1) and (3) are equivalent to each other, we have received another new tool for describing relativistic phenomena in Euclidean space, which is much simpler than the tools in Minkowski space-time.

Therefore, we consider the above problem regarding the Lorentz transformation with the help of a new Euclidean tool.

On a plane with represents the "mixed spaces" Euclidean space we will draw the axes and angles of two "mixed space" coordinate systems x',t and x,t' (fig.1). For simplicity, I used the coordinate system where c=1.

The axes of the coordinate systems x,t, and x',t' presented on this Euclidean plane are not perpendicular to each other; however, there is one important property of such a manner of presentation of relativistic phenomena – namely, the space axis of an observer – x–is always perpendicular to the time axis of the coordinate system of an observed body – t', and the space axis of the observed body – x' – is perpendicular to the time axis of the observer - t.

We can formulate it in the following way:

Conclusion 1: In the Euclidean "mixed spaces" representation, the space axis of the observer must be perpendicular to the time axis of the observed body.

It can be seen that the previous definition of the velocity (5) and the dependence on the time dilation result instantly from fig.1 without any need for mathematical proof:

The velocity is equal to:

$$V = \frac{\Delta x}{\Delta t} = sin\alpha \tag{8}$$

and the rule for the observed time dilation:

$$\Delta t' = \Delta t cos\alpha = \Delta t\sqrt{1 - sin^2\alpha} = \Delta t\sqrt{1 - V^2} \tag{9}$$

Similarly, we can derive the Lorentz transformation:

Let put a point P in the fig.1 and then instantly we can find:

1. The graphical representation of equation (3) in the coordinates of "mixed spaces" created by the coordinate systems x,t' and x',t– fig.2a, where the transition from the coordinate system x',t to x,t' is equivalent to the rotation SO(2) (maintaining m_{12}^2):

$$m_{12}^2 = x'^2 + t^2 = x^2 + t'^2 \tag{10}$$

2. In the same scheme, we can also find dependencies between the coordinates of this point in ***x,t*** and ***x',t'*** coordinate systems – fig.2b.

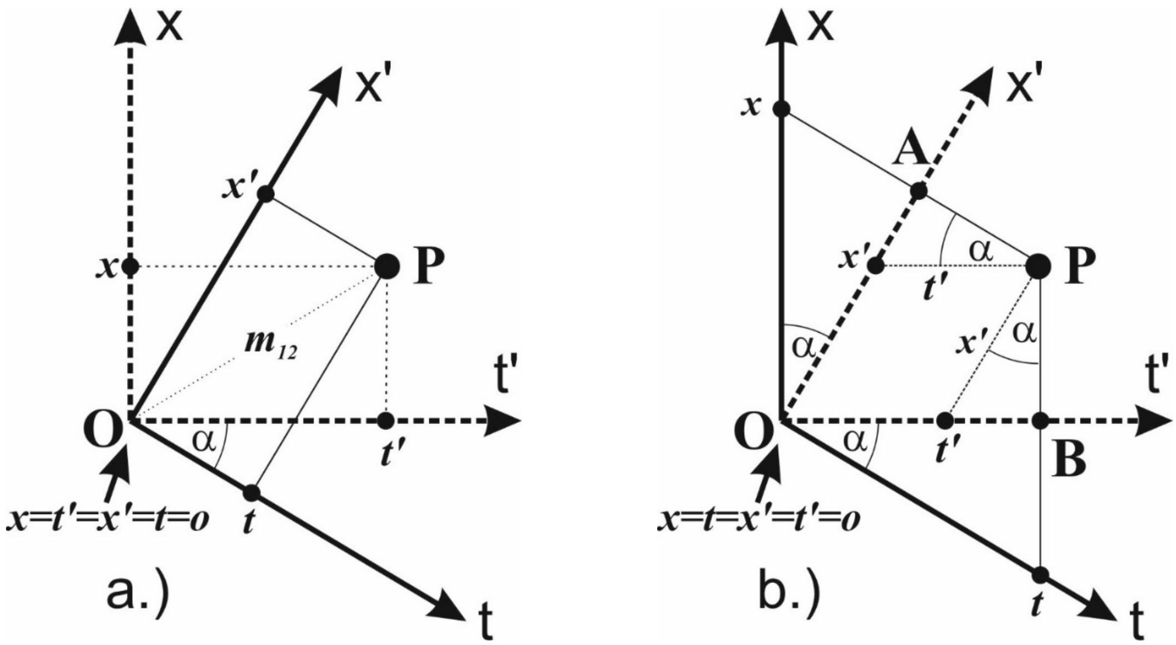


Fig.2 The graphical representation of Euclidean "mixed spaces" coordinates. The coordinates of point P are expressed in relation to the coordinate system of "mixed space" x,t' and x',t – fig.a and in relation to the axes of x,t and x',t' coordinate system – fig.b

From fig.2b we can find that

$$x' = OA - t'sin\alpha = xcos\alpha - t'sin\alpha \tag{11}$$

And :

$$t' = OB - x'sin\alpha = tcos\alpha - x'sin\alpha \tag{12}$$

Then, we receive:

$$x = \frac{x'+t'sin\alpha}{cos\alpha} = \frac{x'+t'V}{\sqrt{1-V^2}} \tag{13}$$

$$t = \frac{t'+x'sin\alpha}{cos\alpha} = \frac{t'+x'V}{\sqrt{1-V^2}} \tag{14}$$

Or

$$x' = \frac{x-tV}{\sqrt{1-V^2}} \tag{15}$$

$$t' = \frac{t-xV}{\sqrt{1-V^2}} \tag{16}$$

Equations (15) and (16) are equivalent to (7); however, they are derived using simple tools.

The graphical presentation of the problems available on the basis of equation (3) is not only connected with simplifying the description of relativistic phenomena. It also provides more information than pure mathematical formulas. Namely, if we present an observation of a specific body in the Euclidean "mixed spaces" space, we must consider **Conclusion 1** stating that **the space axis of the observer must be perpendicular to the time axis of the observed body.**

Such a conclusion has no equivalent condition in the Minkowski space-time, and it introduces the new condition necessary to define the observation in the Euclidean "mixed spaces" space.

Let apply this **Conclusion 1** to the above derivation of the Lorentz transformation.

Let us place a body at point P. To obtain a description of the motion of the body, it is necessary to define the Lagrange function. In turn, this requires knowledge of the coordinates and velocity of the body. In the "mixed spaces" Euclidean space, the velocity is a sine of the angle between the time axis of the observed body and the time axis of the observer. When we measured the distance from point P along the x-axis (fig.3a), according to **Conclusion 1** the axis of time of the body at point P should be perpendicular to the x-axis, and hence parallel to the axis of time t'. This means that the body remains at rest in the coordinate system x',t' (fig.3a).

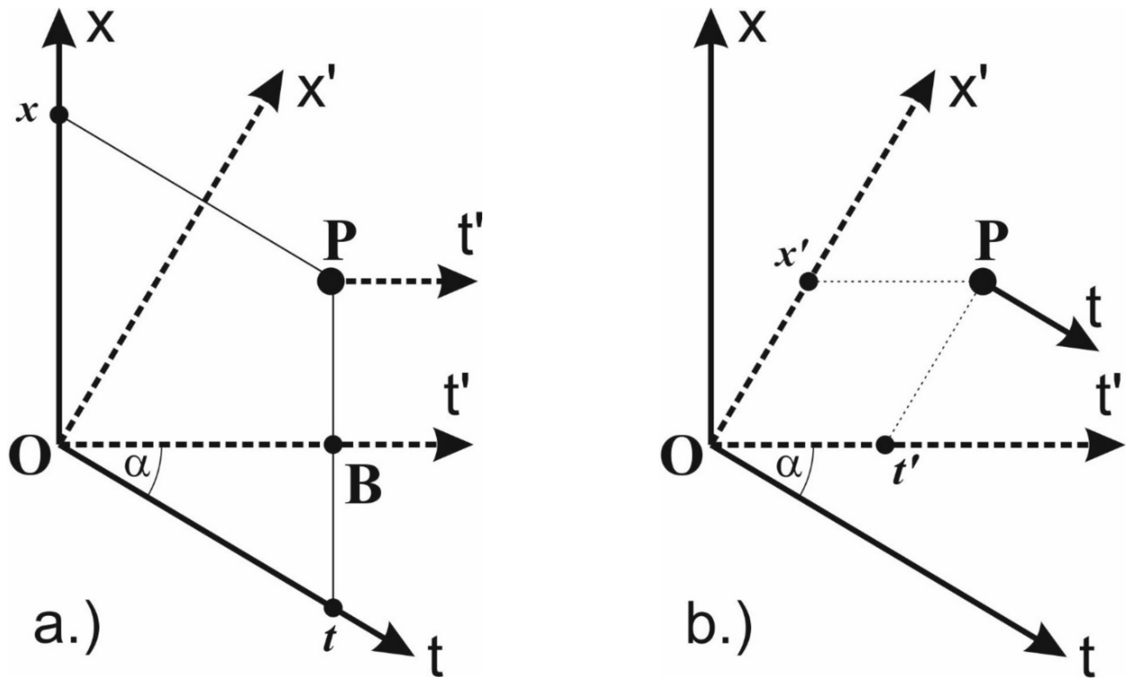


Fig. 3 Observation of a body in point P according to the ***Conclusion 1****. If the distance of body is measured along the x-axis then the time axis of the body in point P is assumed to be parallel to the time axis t' (perpendicular to the x-axis) – fig. 3a. If the distance of the body is measured along the x'-axis then the time axis of the body in point P is assumed to be parallel to the time axis t (perpendicular to this x'-axis) – fig. 3b.*

On the other hand, when measuring the distance of the body at point P along the x' axis, according to **Conclusion 1** the time axis of the body at point P must be parallel to the time axis of the observer's coordinate system t, that is, this body remains at rest in the coordinate system x,t. Therefore, the distances x and x' in equations (11-16) relate to two different bodies – one at the rest in the x,t coordinate system and the second one in the rest in the x',t' coordinate system, and the equations can be true only at the single point where the two bodies meet each other [10].

Therefore, according to the interpretation of the Lorentz transformation in the Euclidean "mixed spaces", the Lorentz transformation, though mathematically correct, has no physical meaning because it cannot be applied to a description of the motion of any specific body.

Therefore, we encountered the following problem. According to this "mixed spaces" example the well known Lorentz Transformation is non-physical. Where is the source of this problem?

Let us take a closer look at the solution of the space-time interval equation.

It should be noted that the number of solutions to equation (1) without any additional assumptions is infinite. I would like to show an exemplary set of equations (for the plane case: y=z=0) being only one class of such solutions, namely,

$$ct = \frac{ct'd + x'e}{\sqrt{d^2 - e^2}} \quad (17)$$

$$x = \frac{x'd + ct'e}{\sqrt{d^2 - e^2}} \quad (18)$$

Variables „d" and „e" in (17) and (18) can be any values or functions, and they are not connected in any way with the space-time dimensions, because substituting (17) and (18) to (1), (for the plane case: y=z=0), causes reducing variables „d" and „e":

$$c^2t^2 - x^2 = \cdots = \frac{c^2t'^2(d^2 - e^2) - x'^2(d^2 - e^2)}{(d^2 - e^2)} \quad (19)$$

Therefore, if these variables are equal to *d=1* and *e=V/c*, then Eqs.(17) and (18) describe the Lorentz Transformation. However, if for instance, we substitute d="size of your shoe" and e="age of your mother in law" then (17) and (18) will still be the solution of (1).

An infinite number of functions can also be found, that for V<<c, give $d \approx 1$ and $e \approx \frac{V}{c}$ which for non-relativistic cases gives on turn the Galileo transformation. There can also be transformations taking forms other than (17) and (18); an example of such a transformation is shown further.

However since the factors "d" and "e" have nothing to do with the variables from the equation (1) and were added arbitrary like these exemplary "size of shoe" or "the age of mother in law", then in order to derive the Lorentz Transformation (LT) from equation (1), the additional assumption is needed. The first such additional assumption can be, as mentioned above, substituting 1 for "d" and V/c for "e"; however, it is difficult to treat it as a proof for the derivation of the LT from (1).

Much better will such "derivation" look if we accept the substitution, where *d=cosh ψ* and *e=sinh ψ*. Then, equations (17) and (18) take the form [12]:

$$ct = ct' cosh\psi + x' sinh\psi \tag{20}$$

$$x = x' cosh\psi + ct' sinh\psi \tag{21}$$

Thus, we can present the transformation of the coordinates as a rotation of a coordinate system in the x,ct plane by an angle ψ, conserving the distance $c^2t^2 - x^2$.

This interpretation is elegant and accepted by physicists. To complete the "derivation", it is necessary to determine angle ψ. We can find it considering motion of the origin of x',t' coordinate system – so we have to assume "x'=0" in (20) and (21) - and then we obtain the formula:

$$tgh\,\psi = \frac{x}{ct} \tag{22}$$

Substituting (22) into (20) and (21), we obtain the Lorentz Transformation [12]

$$t = \frac{t' + x' \frac{V}{c^2}}{\sqrt{1 - \frac{V^2}{c^2}}} \tag{23}$$

$$x = \frac{x' + t'V}{\sqrt{1 - \frac{V^2}{c^2}}} \tag{24}$$

For the first glance the above "derivation" looks like the real solution of the equation of conservation of the space-time interval but in fact it is equivalent to substitution *d=1* and *e=V/c* in formulas (17) and (18), however now justified by mechanism of rotation of coordinate system according to formulas (20) and (21). Meanwhile, there remain still an infinite number of other solutions of (1) and the above "derivation" is rather the overcomplicated proof that LT satisfies the rule of conservation space-time interval than actual finding solution of the problem.

Since this "derivation" is widely applied in the Theory of Relativity, we will follow this reasoning to explain the paradox resulting from fig.3.

As shown above, equation (1) without any additional conditions (here without the condition that the solution has the form (17) and (18) completed by the assumption that *d=1* and *e=V/c*) does not allow determination at the same time of the velocities of an observed body in the coordinate systems of observers xt and x't' and the mutual velocity of the observers (owing to an infinite number of possible solutions).

This is presented in fig.3, where, based on the pure equation (1), without any additional conditions, we were able to determine only the relative velocity of observers – here, the sine of the angle between the time axes (t and t'). However, determining the velocity of the body observed by these observers was not possible, because it required an additional condition that was not present in the diagram. Therefore, we can conclude that the LT derived from fig.2b is non-physical.

In this point we can to sum up:

As shown in formulas (17), (18), and (19) and confirmed in fig.3, drawn on the basis of Gerten's Euclidean approach, the equation of the space-time interval conservation has an infinite number of solutions, and it itself cannot be applied to describe the problem of two observers simultaneously observing a chosen object. To derive the relations between the coordinates of an event in the coordinate systems of the two observers observing the same body, there is an additional assumption that will select the solution (out of the infinite number) properly describing the entire problem.

An example of such a solution is presented in formulas (20)–(24); however, the choice of an additional condition, that is, the solution of type described by (17) and (18) and the additional condition in form $d=\cosh\psi$ and $e=\sinh\psi$ (or $d=1$ and $e=V/c$), was chosen to obtain, as the solution, the Lorentz Transformation, already known before formulating the rule of conservation space-time interval.

Therefore, the additional condition was chosen not because it results from any properties of reality but because it leads to a solution that complies with the solution known before.

However the Gersten's "mixed spaces" Euclidean space introduces one more condition that is a result of properties of the model – namely – the space dimension of the observer must be perpendicular to the time axis of an observed body.

Therefore the problem of two observers observing one body can be presented in the Euclidean space defined by "mixed spaces' Euclidean coordinate system in the following way – fig.4:

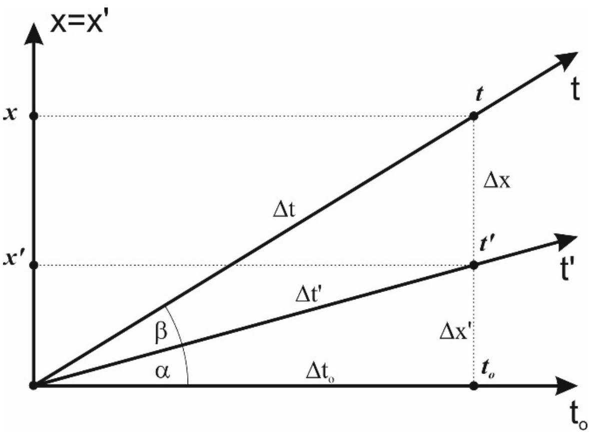


Fig.4 Case of two observers x,t and x',t' observing the same body x_o,t_o The angle β is a measure of the relative speed of observers x,t and x',t': $V=\sin\beta$. The angle α describes the velocity of the observed body x_o,t_o, relative to the observer x't' and $\alpha+\beta$ describes the velocity of the observed body x_o,t_o, relative to observer x,t.

With this additional condition, the space dimensions of all observers of the same body were parallel to each other (perpendicular to the time axis of the observed body). To simplify the presentation, in fig.4, we analyze the case in which these space dimensions overlap and all time axes have a common origin.

According to Gersten, the sine of the angle between the axes of time of coordinate systems of bodies is equal to the relative velocity of these bodies, which enables the consideration of the relative velocity of observers and the relative velocity of the observed body in both observers' coordinate systems. This is not possible in the case presented in fig.3, in which no additional conditions are assumed.

Once we can see that the transformation of coordinates is not only a function of the angle β, here describing the relative velocity of observers because the change in the angle α, where $V = sin\alpha$ is the velocity of the observed body relative to the observer x't', automatically changes the ratio t/t'.

From the relations in fig.4, we can derive new formulas for the transformation of coordinates, where all values are directly related to the properties of the model:

$$t' = \frac{t}{\cos\beta} - \frac{x sin\beta}{cos\beta cos\alpha} \quad (25)$$

$$x' = x - \frac{t sin\beta}{cos\alpha} \quad (26)$$

And the inverse transformation:

$$t = \frac{t'}{cos\beta} + \frac{x' sin\beta}{cos\beta \cos(\alpha+\beta)} \quad (27)$$

$$x = x' + \frac{t' sin\beta}{\cos(\alpha+\beta)} \quad (28)$$

Where

$$sin\beta = V \quad (29)$$

is the relative velocity of observer x',t' in the coordinate system of observer x,t.

$$sin\alpha = v' \quad (31)$$

is the relative velocity of the observed body x_o,t_o in the coordinate system x',t'.

And consequently

$$cos\beta = \sqrt{1-V^2} \quad (32)$$

And

$$cos\alpha = \sqrt{1-{v'}^2} \quad (33)$$

Now, we can rewrite equations (25)–(28) with the help of two velocities, (23) and (24), and the transformations take the following form:

The new transformation of coordinates:

$$t' = \frac{t}{\sqrt{1-V^2}} - \frac{xV}{\sqrt{1-V^2}\sqrt{1-{v'}^2}} \quad (34)$$

$$x' = x - \frac{tV}{\sqrt{1-{v'}^2}} \quad (35)$$

And the inverse transformation:

$$t = \frac{t'}{\sqrt{1-V^2}} + \frac{x'V}{\sqrt{1-V^2}\left(\sqrt{1-{v'}^2}\sqrt{1-V^2}-v'V\right)} \quad (36)$$

$$x = x' + \frac{t'V}{\sqrt{1-{v'}^2}\,\sqrt{1-V^2}-v'V} \quad (37)$$

Eventually, we obtained a new transformation of the coordinates, also satisfying the interval equation (1), and for low velocities, becomes the Galilean transformation. Unlike the Lorentz transformation, (7) and (13-16), the new transformation predicts the time dilation; however, it does not predict the length contraction.

Additionally, this new transformation changes the interpretation of the space-time interval. The equations resulting from fig.4 are as follows.

$$t^2 - x^2 = {t'}^2 - {x'}^2 = t_o^2 \quad (38)$$

To date, the interval described any distance in the Minkowski space-time, and only in the case of observation of a specified body was it equal to the body's proper time. According to the Gersten's model of "mixed spaces" Euclidean space, the additional condition of perpendicularity of the space axis of an observer to the time axis of an observed body, forces the space-time interval to have a sense only in a case of observation of specified body, while it no longer describes the behavior of empty space-time. Fig.3 shows that without knowing the trajectory (in Minkowski space-time, the world-line) of the observed object, the transformation of coordinates cannot be found because, as shown in fig 4, the transformation of coordinates also depends on the velocity of an observed object, not only on the relative velocity of observers as it takes place in Minkowski space-time.

An advantage of the new transformation is that it does not predict length contraction, which, unlike the case of time dilation, was not experimentally confirmed.

If length contraction does not occur, how can the constancy of the speed of light be justified?

The mechanism of propagation of light ensuring its constant velocity does not require the length contraction any more and it is presented in my papers regarding the model of Euclidean reality, similar to the Gersten "mixes spaces" idea. [7,8]

3. Can Gersten’s idea of “mixed spaces” be treated as the model of reality alternative to Minkowski space-time?

In Minkowski space-time, one observer can observe many objects simultaneously, and the coordinate systems of these observed objects are deformed according to the Lorentz Transformation, which is treated as the solution of the rule of conservation of the space-time interval. Thus, Minkowski space-time describes reality exactly as the observer sees it.

In the Gersten “mixed spaces” Euclidean space-time, an observer can simultaneously observe only one body; however, here on turn, one body can be observed simultaneously by an infinite number of observers (fig.4) (equation (3) can be written only for a pair of bodies or for many bodies observing the same, single body as in fig.4). Hence, the “mixed spaces’ Euclidean model describes the same problems as the Minkowski approach, but here it is distinguished the observed body, unlike in Minkowski space-time, where it is distinguished the observer.

Therefore, both the Minkowski and Gersten models describe the same problems, but from a different point of view, so we could expect that these two models have identical solutions. However, the new interpretation of the space-time interval resulting from Gersten’s approach causes certain differences, such as the new rule of transformation of coordinates. A description of these and other consequences of the alternative approach can be found in [7,8,9,13].

So, can be the “mixed spaces” idea, a basis for constructing the reliable model of Euclidean reality then?

Let us consider the problem of two observers observing an object, as illustrated in fig.4. A slight overview of this problem is shown in fig.5.

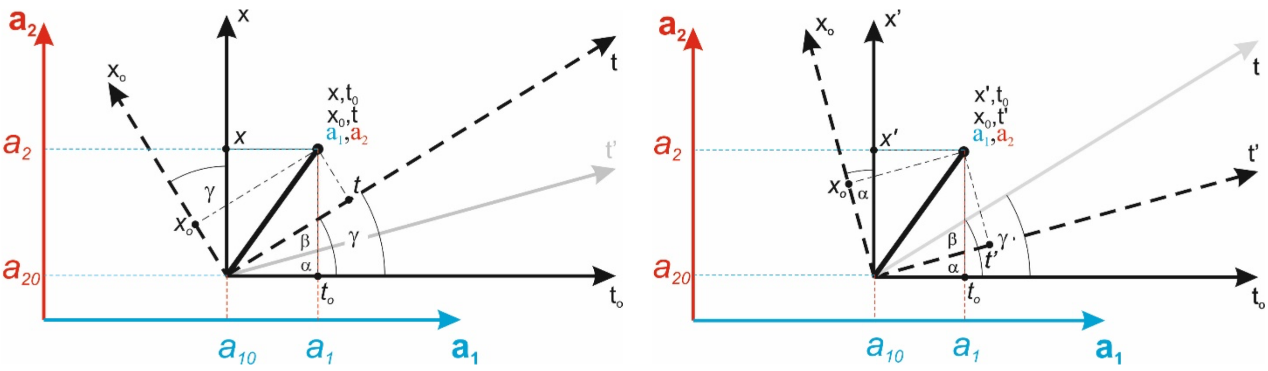


Fig. 5 The Euclidean plane described by various “mixed spaces” coordinate system can be also described with the Euclidean coordinate system (for instance a_1,a_2,a_3,a_4) not bound with any body/observer. Presented is the mutual observation of observers presented in fig.4. Here we are considering the mutual observation of pair of bodies i.e. x_0,t_0 and x,t (fig.a) and x_0,t_0 and x',t' (fig. b). All the “mixed spaces” coordinate systems are chosen in a manner conserving the distance $(a_1-a_{10})^2+(a_2-a_{20})^2$ in the common coordinate system a_1,a_2, ($a_3=a_4=0$). Due to the codition saying that the space dimensions of an observer must be perpendicular to the time axis of the observed object, the x_0 axis in fig.a (where it is perpendicular to t axis) differs from the x_0 axis in fig.b (where it is perpendicular to the t’ axis) .

The Euclidean plane is described by the “mixed spaces” coordinate systems, that is, $x_o t$, xt_o,,$x_o t'$ and $x't_o$. All these coordinate systems are describing in fact in the same Euclidean plane (here, we are still considering the case y=0 and z=0); therefore, we can also describe this plane with the Euclidean coordinates a_1, a_2, (for the case where $a_3=0$, and $a_4=0$), which are connected with the plane and not with any of the observers. If we choose any point a_1,a_2 in the Euclidean plane and assume that all time axes of the observers t, t’ and t_o has their origin at points a_{10},a_{20} then equation (3) (for this point expressed in all of the described coordinate systems) –will take the form:

For the pair of observers from fig.5a

$$t^2 + x_o^2 = t_o^2 + x^2 = (a_1 - a_{10})^2 + (a_2 - a_{20})^2 \qquad (40)$$

And for the pair of observers from fig.5b

$$t'^2 + x_o^2 = t_o^2 + x'^2 = (a_1 - a_{10})^2 + (a_2 - a_{20})^2 \quad (41)$$

Note that equation (3) has a sense only for a single pair of objects: the observer and observed body.

As we see, the distance in the Euclidean space between two points (a_1,a_2) and (a_{01},a_{02}) can be described with the help of the coordinate systems of the observers in various coordinates – here x,t; x',t' x_o,t_o, where the coordinate systems of all observers must satisfy equations (40,41), Hence, any change in the pair of coordinate systems (the observer and the observed body) does not change the measured distance.

Therefore, instead of considering any problem in the Euclidean space constructed with the help of space-time coordinate systems of bodies, where the description differs from one coordinate system to the other, let us try to solve the problem in a coordinate system "$\mathbf{a_i}$" bound with the Euclidean plane and not with any of the bodies, and then transform the result to the coordinate system of a chosen observer.

Such an action can be treated as a mathematical trick or curiosity; however, I would like to treat it more seriously. In other words, I would assume the Euclidean "$\mathbf{a_i}$" space as the model of "true" reality.

At first glance, it looks like an absurd assumption because if a coordinate system describing the reality is not connected with any observer but with Euclidean reality, then we deal with the absolute space, which contradicts the results of the Michelson Morley experiment. Moreover, the direction of the time axis of the coordinate system of a body differs from one body to another. Therefore, the problem arises as to how to define the time axis in such a space.

But try do not give up. Let start from the very beginning.

At first – the time axis.

In the Euclidean E4 space, all four dimensions are identical, and none of them is the time dimension. In the fig.4 and 5, the representation of the E4 space (where a3,a4 = 0) is the surface of the diagram. As shown in fig.5, the time axis of a specified body is in line E4 which can be described by the following formula:

$$a = a_0 + \vec{\boldsymbol{v}}T \quad (42)$$

Where

point of the line $$a = \begin{pmatrix} a_1 \\ a_2 \\ a_3 \\ a_4 \end{pmatrix} \quad (43)$$

starting point $$a_0 = \begin{pmatrix} a_{10} \\ a_{20} \\ a_{30} \\ a_{40} \end{pmatrix} \quad (44)$$

a directional vector $$\vec{v} = \begin{pmatrix} v_1 \\ v_2 \\ v_3 \\ v_4 \end{pmatrix} \quad (45)$$

T – parameter $T \epsilon R$

If we now subtract the two points of the line – a1 and a2, we obtain: $a_1 - a_2 = \vec{\boldsymbol{v}}(T_1 - T_2) = \vec{\boldsymbol{v}}\Delta T$

Because the length of the time axis of a body is a measure of the time passed in the body's coordinate system, we can write:

$$\Delta t = |\vec{\boldsymbol{v}}|\Delta T \quad (46)$$

This implies that the time flow is in E4 equivalent to the motion of a body along the direction of the time axis of its coordinate system in E4. The vector $\vec{\boldsymbol{v}}$ describes the motion velocity. The simplest form of this equation assumes that, for all bodies in E4, the module of this velocity is equal to unity: $|\vec{v}| = 1$.

In such a case, parameter T equals the time flowing in the coordinate system of the body.

However, in Euclidean space, all lines – here, the coordinates of objects – are on the same scale; therefore, the parameter T should be identical for all bodies. In other words, time should flow at an identical speed in all coordinate systems.

Therefore, we have a model in which the space is four-dimensional and Euclidean, and described by an absolute coordinate system. In this space, bodies are present. The bodies move along certain trajectories with a constant (absolute) speed $|\vec{v}| = 1$. The trajectory traveled by any body is a measure of the time indicated by the body's clock. These times are identical for all the coordinate systems.

Such a model completely contradicts the Theory of Relativity, and it looks like it came back to the 19-th century understanding of reality, where we had absolute Euclidean space filled with hypothetycal Aether, and the absolute time common for all objects. So, did we make a mistake and further discuss this model has no sense?

However, there is one very important difference between 19-th century idea of reality and the proposed approach. Namely, the fourth dimension of the Euclidean space is identical to the three remaining dimensions. This fourth additional Euclidean dimension allows us to introduce relativistic phenomena to this, absolute for now, the model of reality.

Based on the above considerations, we can determine the idea of time. The time measured by the body is the length of the trajectory traveled by the body in E4. As shown in fig.5, the trajectory of each body is interpreted by this body as the time axis of its coordinate system. This means that there is no common time dimension for all bodies. The common parameter is T, but the time axis is not the dimension but the direction in E4 space, and this direction is generally different for each body. The bodies perceive the time flow as the path traveled in E4. Thus, the observer's clock can be imagined as a kind of mileage counter similar to that applied in a car. Now, we should consider how bodies perceive space dimensions.

We must be aware that we do not observe any space. Space is not a highway with bollards, which allows us to determine the distances and speeds. Only information about the existence of space is obtained by observing the surrounding bodies. This observation is made with the help of exchange interactions. If we observe bodies treated as material points, the number of observed degrees of freedom of the surrounding bodies provides information regarding the number of space dimensions. Because we observe other bodies with the help of exchanging interactions, the number of linearly independent directions of propagation interactions sent and received by bodies must be equal to the number of observed dimensions. Hence, if, for instance, in a 10-dimensional space, exist bodies sending nad receiving interactions in/from three linearly independent directions, then by observing these bodies, we will be convinced that we are living in the three-dimensional space. The difference between the true number of dimensions of space and the observed three dimensional motions of the surrounding bodies will reveal to us in a the form of certain other phenomena.

Let's come back to our model then.

Because one of the directions in E4 is reserved for the trajectory describing the time flow, we now assume that the three remaining directions perpendicular to the trajectory of the observed body will be perceived by an observer as space dimensions. A detailed explanation of why bodies sending and receiving interactions in three directions perpendicular to their trajectories finally interpret directions perpendicular to the trajectory of an observed object as their space dimensions can be found in [7,8], and the model of particles justifying such a mechanism can be found in [13].

Therefore, from the manner in which we observe the reality results, that the directions in E4 perceived as space dimensions must be perpendicular to the trajectory of the observed bodyor, in other words, to the axis of time of the observed body coordinate system. Therefore, according to the new approach, the description of Gersten's "mixed spaces" is a result of such a perception of bodies in the E4 space. However, what we perceive as space-time dimensions are now the directions in E4 space, and these directions are different for the observation of different bodies.

OK, one can say. Therefore, if the directions of trajectories (i.e., time axes) of all bodies in E4 differ from each other, why do we not see the difference between the directions interpreted as the space-time dimensions for other bodies?

On a daily basis, we live in a non-relativistic world. Therefore, the trajectories of all bodies – people, buildings, jets, cars, higways, landscapes, and surrounding celestical bodies–are practically parallel to each other, so we can say that one of the dimensions of E4 is "reserved" to be a common time axis for all these objects. The three remaining dimensions of E4 are then the space axes of all the coordinate systems of these objects, and they are practically identical for all bodies. Thus, by observing the surroundings, we perceive one time dimension and three space dimensions as common to all bodies.

We observe objects such as a camera; we receive signals at multiple points, such as on a camera matrix, and each point receives signals that change over time. From these multiple points, we build a picture of the reality similarly as we build the picture of this text looking at the computer screen, where the image consists of points flicking in different locations and at different times. This creates an image of the reality registered by our brains.

Now, if a relativistic particle appears, we will observe it along a different direction in E4 than for the rest of the surrounding objects; however, we will be unable to determine whether these directions in E4 are different for this particle than for the rest of the objects. The differences in the directions interpreted as space dimensions during the observation of this relativistic body will be observed as realistic effects. Thus, if the number of observed dimensions is lower than the number of dimensions of reality, this difference appears in our reality in the form of relativistic pehenomena.

Therefore, starting from Gersten's idea of so-called "mixed spaces", we came to the model of Euclidean reality. As shown in fig.6, the difference between the Minkowski space-time (fig. 6b) and Euclidean four-dimensional reality (fig. 6a) consists of the position of the right angle in the triangle built of space-time dimensions of the observer and the trajectory (world line fig.6b) of the observed body.

In the Minkowski space (fig. 6b), we assume a right angle between the space and time axis of the observer. This describes a situation identical to that observed in non-relativistic surroundings. The assumption of the shape of reality is identical to our non-relativistic surrounding, forcing the need to apply a complicated coordinate system causing deformation of the axes of the coordinate systems of bodies in motion, as shown in fig.6b.

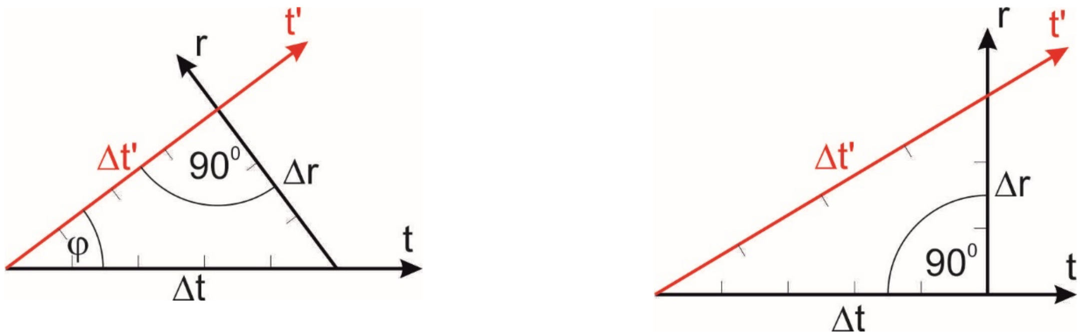


Fig. 6 Comparision of the Euclidean and Minkowski models. Space-time axes of the observer and the time axis of an observed object are presented in arbitrary units where Δt=5, Δt'=4, Δr=3

a.) In Euclidean four dimesnional space all axes are presented in the same scale.

b.) In Minkowski space-time in order to conserce the right angle between the space-time axes of observer, the axes of observer's coordinate system are deformed.

On the other hand, if we assume that the observed space-time axes are only certain directions in a four-dimensional Euclidean space, and these directions are determined by the observation of surrounding bodies, then we obtain a model of reality where the right angle is positioned between the time axis of an observed object and the space axis of the observer (fig 6a). Such a picture of reality differs from its observed shape, but we should get used by now to the fact that true reality can differ from its observed shape. For instance, observing the Sun traveling through the sky, we know that its motion is only an impression, while it is really the Earth that is moving around the Sun.

Such Eclidean approach, though less intuitive, gives us a new understanding of the reality. It has significant advantages over the "classic" Theory of Relativity.

The first significant advantage of the new idea is the possibility of connecting two contradictory ideas, absolute space, absolute motion, and the relativity of motion.

While bodies move in E4 with an absolute velocity equals to unity ($|\vec{v}| = 1$) along their trajectories, the relative velocity of bodies is determined by the angle between the trajectories of bodies, as shown in fig. 6a.

$$V = \frac{\Delta r}{\Delta t} = \sin\varphi \tag{47}$$

Such defined velocity differs from the one defined in (5) due to the fact that all dimensions in E4 are represented in the same units, so the ratio of the space units to the time units, in other words the speed of light "c", equals to unity.

Since in E4 there are no any distinguished directions, then such defined velocity is relative because the angle of a chosen trajectory can be determined only in relation to the trajectory of the other body. Therefore, this model includes both the idea of absolute space E4 and the idea of relative motion of bodies in this space.

The next advantage of the Euclidean approach is that it explains relativistic phenomena not as a result of deformation of coordinate systems of bodies in motion, but as a result of interpretation of different directions in E4 as space dimensions. The absence of coordinate deformation significantly simplifies the mathematical description of the physical problems.

How does it work?

In E4, time flows identically in the coordinate systems of all the objects (for straight trajectories, which are equivalent to inertial motions [7,8]). However, the observation is performed along directions perpendicular to the trajectory (time axis) of the currently observed object, being the space axis of the observer's coordinate system during the observation of the body (fig. 6a). This causes the observer to register that the observed body time flows slower than in his reference system, and from fig.6a, instantly results in the following:

$$\Delta t' = \Delta t \cos\varphi = \Delta t\sqrt{1 - sin^2\varphi} = \Delta t\sqrt{1 - V^2} \qquad (48)$$

This is not the actual time dilation but only the observed dilation. If we switch the roles of the observer and observed body, we see that this problem is symmetrical for both observers [8,13] as long as the bodies move along rectilinear trajectories (with inertial motions). To register the true dilation of time, one of the objects must change its velocity. This has been explained in detail in previous papers [8,13].

This new approach opens up significant possibilities for the description of particles. The constant motion of bodies along their trajectories allows for direct definition of a particle as a wave [7,8,13]. The interpretation of the relative velocity as an angle between trajectories changes the problems of the motion with the speed of light and faster-than-light travel. At the same time, the speed of light is quite different from the relative speed of bodies, although we observed both types of velocities as if they were the same phenomenon [8]. The Mach principle, singularities, results of the Michelson–Morley experiment, and many other problems can be easily solved in Euclidean reality [7,8,13]. Therefore, the new Euclidean approach seems to be promising and should be considered further.

Gersten's idea of "mixed spaces" proposes the foundations for a new model of reality, although a description of this reality directly with the help of space-time dimensions is not possible. The idea of so called "mixed spaces" is rather the result of the Euclidean shape of the reality built of different than space-time Euclidean dimensions, however the Gersten's work was most probably the first paper published in the mainstream Journal, presenting the main idea of the new Euclidean approach.

4. Conclusions

This new concept of reality can change our ideas about the world in which we live. This simplifies the description of events; however, in most cases, it leads to conclusions that are similar to the Theory of Relativity. There are also some new conclusions [9, 11], some different ones (such as the new transformation of coordinates presented here), and some different interpretations of well-known phenomena [9] or even a proposal of experiments that can test the correctness of this approach [11].

One of the most important conclusions from the Euclidean approach is the possibility of connecting the two ideas assumed for over a hundred years to be contradictory, namely, an absolute coordinate system and relativity of motion. This, in turn, allows us to describe a body directly as a wave moving with a constant velocity in E4, where the relative velocities of such waves are functions of the angle between the propagation directions of these waves [7,8,13]. Therefore, if, in Minkowski space-time, a particle can be described as a discrete particle with wave properties described by a wave function, then in Euclidean reality, the particle can be described directly as a wave. If the wave has an additional phase velocity along its ridge equal to unity, then we can describe the interactions and propagation of light not as an exchange of quatums, treated as separate particles, but as an exchange of disturbances propagating along the ridge of waves with the phase velocity equal to unity [7, 14, 15]. This introduces the speed of light and quantums as an integral property of particle-waves.

Moreover, the new interpretation of space–time dimensions instantly explains the recession of the galaxy phenomenon and the origin of Hubble's constant [9]. The new coordinate system treats singularities as limitations regarding observation, rather than real limitations of phenomena [8]. The relativity of motion, defined as the angle of inclination of the trajectories of particles/waves, can be applied only to rectilinear trajectories. While the angle between trajectories (the relative velocity) is in the E4 space relative, the curvature of the trajectory (acceleration), considered in E4, does not depend on the angle of the trajectory; therefore, the non-inertial motions cannot be traeted as relative, which instatnly explains the Mach principle [8]. These and many other new phenomena allow us to expect the Euclidean idea of reality to be a step in the right direction. Hence, it should be seriously considered as a potential alternative approach to the idea of Minkowski space-time.

Independent of any new conclusions resulting from the new approach, the main question put in this paper is: Does reality look like we observe it, or what do we see is merely a certain projection of the real world?

A difference between the observed and real worlds was discovered for the first time by Copernicus and Galileus, who claimed that the motions of celestial bodies observed on the firmament differ from their real motions performed in the universe. Currently, we assume that the observed space-time dimensions are the true dimensions that create reality. In other words, we assume – like 19 centuries ago, Ptolemy did – that the observed shape of the world is its true shape. The new approach presented here contradicts this claim. It seems possible that the observed space-time dimensions can also differ from the "true" Euclidean dimensions, creating reality, similar to the observed motions of planets on the firmament, which differ from their real motions.

Therefore, this is a serious and still unsolved problem, and I hope that this paper will begin once more this discussion started 400 years ago.

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