Natural Control of Energy Material Processes and Theory of Relativity

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Abstract: - The analogue of the equations of the general relativity theory out of formalism of Riemannian geometry is constructed. The degree of equivalence of the obtained equations to the Einstein equations is investigated. It is shown that natural control is possible at weak field information interactions, which are described by general relativity theory equations. Such natural control of energy material process by means of change of its derivatives is realized by information space signal. The physical effect together with the device for its observation is described, which partially justifies presence of some structure of the space, such as curvature, metrics and deformations, as well as interaction of this structure with material energy processes.

Key-Words: - general relativity theory, special relativity theory

1 Introduction

In [6] it was shown that the special relativity theory is only a consequence of the general relativity theory. Thus, the basic equations of the general relativity theory are fundamental. They describe also a presence of a weak information field in any energy process. Some aspects of such fields interaction were investigated in the paper [6].

The basic doctrine of the general relativity theory is simple enough: energy and impulse change a structure of space. However, the question occurs: such changes of the space structure can be described only by means of Riemannian geometry or some simpler formalism is possible?

There exists a very similar analogue. In theory of elasticity a material medium in the absence of deformations is described by Euclidean space and orthonormal coordinate system. However, the orthonormal system in the presence of deformations changes into a curvilinear one: angles between basis vectors as well as their lengths change, and now these parameters are defined by some nonlinear functions of coordinates. In this case a local coordinate system at each point is strongly connected with a deformable material medium. Thus, a stressedly-deformed state may be described by means of Riemannian geometry and that is used in some cases [1]. Nevertheless, it is more convenient to use concepts of stresses and
deformations, which are formulated in Euclidean space for an orthonormal coordinate system. More precisely, in theory of elasticity there exist three almost equivalent theoretical possibilities: description only by means of Riemannian geometry; combined description both by means of Riemannian geometry and using concepts of stresses and deformations; using only concepts of stresses and deformations, which are formulated in Euclidean space. The last one is used mostly as the most simple and effective, especially in technical applications, although the means of Riemannian geometry are naturally richer.

2 Problem Formulation
Similarly to deformations of a material body, which are formulated for a continual medium but not for a discrete one, it is possible to introduce definitions for deformations of space and vacuum. Practically, any field in vacuum may be interpreted by appearance of appropriate deformations of space. Then there exists a possibility in the most cases to abandon application of Riemannian geometry and to formulate equations of the general relativity theory in Euclidean space, but using concepts of deformations of that space. Such approach is connected in no way with a concept of ether as it expects a presence of deformations of a continuous medium, but not a discrete one.

If at some point there exist deformations of space then at that point a material medium may be absent at all or, on the contrary, the material medium at that point may additionally have usual elastic deformations.

Let us write the Einstein equations in the Riemannian formalism [2, 4]:

$$\alpha T_{ij} = R_{ij} - \frac{1}{2}RG_{ij},$$

where $T_{ij}$ is the impulse-energy tensor, $R_{ij}$ is the Ricthy tensor, $R$ is the scalar curvature in pseudo-riemannian space, $G_{ij}$ is the metric tensor, and $\alpha$ is the numerical coefficient.

Let us use the variational principle for derivation of equations similar to equations (1) but using a formal apparatus of space deformations. Equations (1) are mostly obtained according to the principle of the least action [2] by variation of a sum of actions for a certain kind of material energy and an action, which corresponds to that energy of the spatial or vacuum field:

$$\delta(s_m + s_p) = 0,$$

where $s_m$ is the action for the matter, and $s_p$ is the action for the space field.

If we introduce densities of Lagrange functions for $s_m$, $s_p$ and use a known formal method of the functional variation, we will have Lagrange-Euler equations for the sum of densities of Lagrange functions [3]:

$$\frac{d}{dt} \frac{\partial (L_m + L_p)}{\partial \dot{x}_i} - \frac{\partial (L_m + L_p)}{\partial x_i} = 0,$$

where $x_i$ are generalized coordinates, and $x'_i$ are generalized velocities. The equations (3) reduce to identity at $L_m + L_p = 0$. This case is considered below.

3 Relativity Theory and Space Characteristics
As it is well known, the density of the Lagrange function for the material medium is equal to the difference between kinetic energy and potential energy at an arbitrary point $x$:

$$L_m(x) = \frac{\mu v^2(x) - u(x)}{2},$$

where $\mu$ is generalized density.

Kinetic energy of motion brings to the change of lengths, i.e. energy of deformation of space stress $1/2 \sum_{i,j} \theta_{ij} \theta_{ij}$ corresponds to the kinetic component in $L_m$, analogously to the similar component in the elasticity theory [1, 5]. Energy of deformations of the space shear $1/2 a \sum_{i,j} \tau_{ij}^2$ $(i \neq j, \tau_{ii} = 0)$ corresponds to the potential component in $L_p$. The space is considered as a homogeneous and isotropic one. Thus, from $L_m + L_p = 0$ we obtain:

$$\frac{\mu v^2}{2} - u = \frac{1}{2} a \sum_{i,j} \tau_{ij}^2 - \frac{1}{2} b \sum_{i,j} \theta_{ij} \theta_{ij}.$$

Without restriction of generality we may write (5) in the form

$$\alpha (\mu v^2 - \gamma u) = \sum_{i,j} \left( \tau_{ij}^2 - \frac{1}{2} \beta \theta_{ij} \theta_{ij} \right),$$

where $\gamma$ and $\beta$ are numerical coefficients.
where \( v \) is the velocity of the mass point; \( u \) is the density of potential energy; \( \mu \) is the density; \( \tau_{ij} \) are deformations of the space shear; \( \theta_{ij} \) are deformations of the space stress-strain; and \( \alpha, \beta, \gamma \) are some numerical coefficients.

Now let us try to formulate (6) in a tensor form. For the left-hand part let us enter the impulse-energy tensor \( T_{ij} \), such that
\[
\sum_{i,j} \alpha T_{ij} = \alpha \left( \mu v^2 - \gamma u \right).
\]
In this case instead of (6) it is expedient to consider the component-wise equality:
\[
\alpha T_{ij} = \tau_{ij} - \frac{1}{2} \beta \theta_{ij} \theta_{ij}. \quad (7)
\]
The equations (7) are the analogue of the equations of the general relativity theory, which is formulated with the help of concepts of space or vacuum deformations, but not the continuous material medium.

4 Investigation of Equivalence of Equations in Deformations and Equations in the Riemannian formalism

Let us consider a degree of equivalence of the formulated equations to the Einstein equations (1). In [2] the geometrical sense of the curvature tensor is presented by the next formula:
\[
\Delta A_k = \frac{1}{2} R_{klm} A_l \Delta s^{lm}, \quad (8)
\]
where \( A_k \) are components of an arbitrary vector \( A \); \( \Delta A_k \) is the \( k \)-th component of deviation \( \Delta A \) of the vector \( A \), which is carried in a parallel way to itself along the infinitesimal closed loop \( \Delta s \); \( \Delta s^{lm} \) is the projection of the loop onto the coordinate plane \((l,m)\); \( R_{klm} \) is the curvature tensor. In the right-hand part of (8) it means a summation on repeating indexes.

According to (8), an analogous approximate formula may be obtained also for the Richy tensor, as it is a convolution of the curvature tensor \( \sum_i R_{klm} = R_{km} \):
\[
\Delta A_k \approx l \Delta s R_{km} A_m, \quad (9)
\]
where \( l \) is some constant; \( \Delta s \) is a quantity of the infinitesimal closed loop.

On the other hand, it is obvious that the displacement angle \( \gamma \) from the initial position of the vector, which is carried in a parallel way along the infinitesimal loop, is proportionate to the work of corresponding forces. In the considered case, the work corresponds to energy of deformations of the space shear, i.e. at small angles for the projections of the displacement angle, we have:
\[
\gamma_{ij} \approx k \tau_{ij}^2. \quad (10)
\]
It is clear that the formulas (8), (9) are correct also at contraction of the loop \( \Delta s \) to point, i.e. when there exists the limit of the ratio \( \Delta A_k / \Delta s \). Here, only the proportionality factor changes. These formulas allow also to conclude that, for small displacement angles, the components both of the curvature tensor and of the Richy tensor are proportionate to corresponding components of the angle of the vector displacement from the initial position. Here, we take into account that the sinus of small displacement angles are approximately equal to the angles, and the ratio of the projection of the displacement vector to corresponding projection onto the coordinate plane of the vector self determines the sine of corresponding projection of the displacement angle:
\[
\frac{\Delta A_i^2 + \Delta A_j^2}{\sqrt{\Delta A_i^2 + \Delta A_j^2}} = \frac{\Delta A_y}{A_y} \approx \sin \gamma_{ij} \approx \gamma_{ij}. \quad \text{Therefore, the}
\]
next approximate equality takes place:
\[
\gamma_{ij} \approx q R_{ij}, \quad (11)
\]
where \( q \) is some constant.

Combining (10) and (11), we obtain
\[
R_{ij} \approx d \tau_{ij}^2, \quad (12)
\]
where \( d \) is constant. In this way, the Richy tensor is proportionate to corresponding components of the tensor of energy of the space shear deformations.

Now let us consider values of the metric tensor \( G_{ij} \), presented in the right-hand part of (1). The metric tensor is equal to the scalar product of the corresponding basis vectors:
\[
G_{ij} = n_i n_j \cos \alpha_{ij}, \quad (13)
\]
where \( n'_i, n'_j \) are lengths of corresponding basis vectors of the curvilinear coordinate system; \( \alpha'_{ij} \) is the angle between them. It is taken into account that \( \cos \alpha'_{ij} \approx 1 \) at small deformations of the space shear, i.e. at small values of the curvature.

Simultaneously we have

\[
n'_i = n'_i - l'_i = \theta_{ii}, \tag{14}
\]

where \( n_i \) is the unit vector of the initial Euclidean coordinate system and \( n'_i \) is its new length in the curvilinear coordinate system; \( l'_i \) is an arbitrary length before deformation; \( l''_i \) is the same length after deformation; \( \theta_{ii} \) is the deformation of the space stress-strain.

Thus, the formula (14) defines the deformation of the space stress-strain in the direction of the \( i \)-th axis. Therefore, we can write

\[
G_{ij} \approx n'_i n'_j = \theta_{ii} \theta_{jj}, \tag{15}
\]

where \( \theta_{ii} \) and \( \theta_{jj} \) are corresponding components of the deformation of the space stress-strain.

Formulas (12), (15) allow to draw a conclusion about the equivalence of the right-hand parts of the equations (1) and (7) at small deformations of the space shear, i.e. at small values of its curvature, accurate to constant factors. We do not determine the coefficient \( \beta \) in (7), whereas in (1) the corresponding coefficient near the metric tensor is equal to the scalar space curvature \( R \).

Some differences take place also during determination of the impulse-energy tensor in (7) in comparison with (1). The most natural way to define the impulse-energy tensor in (7) is as follows.

\[
T_{ij} = \delta_{ij} \left( \mu v_i v_j - \frac{1}{3} \gamma u \right), \tag{16}
\]

where \( v_i, v_j \) are corresponding components of the generalized velocity; \( u \) is potential energy; \( \delta_{ij} \) is unit semi-antisymmetric tensor, such that \( \delta_{ij} = 1 = -\delta_{ji} \) at \( i \neq j \) and \( \delta_{ii} = 1 \). A summation on repeating indexes in (16) is not carried out. Simultaneously,

\[
\sum_{i,j} \alpha T_{ij} = \alpha \left( \mu v^2 - \gamma u \right), \tag{17}
\]

i.e. a component-wise summation of the equations (7) leads to equation (6). The notation of \( T_{ij} \) in such form implies practically that depending on the sign of the right-hand part in (7), the one of the next two possibilities may be realized:

\[
\tau^2 - \frac{1}{2} \beta \theta_{ii} \theta_{jj} = \left\{ \alpha \left( \mu v_i v_j - \frac{1}{3} \gamma u \right), \alpha \left( \frac{1}{3} \gamma u - \mu v_i v_j \right) \right\}. \tag{18}
\]

In Einstein equations (1) the tensor \( T_{ij} \) has a little different form [4]:

\[
T_{ij} = \mu v_i v_j, \ i, j \neq 0. \tag{19}
\]

Here the term corresponding to the potential energy is absent, and there is no possibility of variation of sign before \( T_{ij} \). However, \( R_{ij} \) and \( G_{ij} \), which enter into (1), are independent tensors. Therefore, one should not eliminate, at least formally, situations when the right-hand part in (1) is negative. However, the expression (19) for \( T_{ij} \) leaves out of account such possibilities.

Both equations (1) and (7) are formulated in the "energy" form. If similarly to space deformations we introduce concepts of space stresses, then it is obvious that equations for forces may be also derived. It is natural that such equations will not be an analogue of the equations of the elasticity theory. Besides, the next question appears: why the space is modelled as an analogue of solid and not an analogue of liquid or gas? In liquids and gases shear deformations are absent, i.e. translating model onto space, the curvature tensor should correspondingly have always zero components. In addition, space shear deformations, i.e. the presence of its curvature, may generate not only corresponding potential field, but also any rotations.

### 5 Control by Means of the Space Interaction

Let us denote the right-hand part of (7) as \( \lambda_{ij} \):

\[
\lambda_{ij} = \tau^2 - \frac{1}{2} \beta \theta_{ii} \theta_{jj}. \tag{20}
\]

Now let us write (7) for some point A:

\[
\alpha T^*_{ij} = \lambda'_{ij}. \tag{21}
\]
Let us suppose that at the point B there also occurs some process, which has a space interaction with the point A. Then the equations (21) have the next form:

$$\alpha T_{ij} = \lambda'_{ij} + \varphi \lambda_{ij}, \quad (22)$$

where $\lambda_{ij}$ are the parts of the space deformations, which are specified by the field interaction of the point A with the point B; $\varphi$ is some numerical coefficient. As in most cases the values $\lambda_{ij}$ are very small in comparison with $\lambda'_{ij}$, the values of the components of the impulse-energy tensor $T_{ij}$ have only small differences from corresponding components of $T'_{ij}$.

Let us differentiate (22) on time:

$$\alpha \frac{\partial T_{ij}}{\partial t} = A_{ij}(t) + \varphi u_{ij}, \quad (23)$$

where $A_{ij}(t) = \frac{\partial \lambda'_{ij}}{\partial t}$ and $u_{ij} = \frac{\partial \lambda_{ij}}{\partial t}$.

Equations (23) are the classical equations with the linear control $u_{ij}$ and without an absolute term. The functions $A_{ij}(t)$ are supposed to be known. In (22) the additional term $\lambda_{ij}$ has a very small influence on the value of the impulse-energy tensor $T_{ij}$. However, the control $u_{ij}$ in (23), i.e. the derivative $\frac{\partial \lambda_{ij}}{\partial t}$, may have a significant influence at least at some intervals. Therefore, the function $\frac{\partial T_{ij}}{\partial t}$ may be greatly different from $\frac{\partial T'_{ij}}{\partial t}$, which is a derivative of the left-hand part in (21). Thus, the equations (22) are correct only in a small neighbourhood of the point $t_0$, and further $T_{ij}$ are already determined by the solutions of (23).

Thus, an influence of the control of a weak information signal, which is transmitted by means of a space interaction described by the equations of the general relativity theory, may be carried out by changing the first derivative of the impulse-energy tensor on time. The possible mechanism of the control with the help of the higher derivatives was investigated in [6].

### 6 Description of the Experiments

Here we briefly describe some experimental material with supposed presence of field interactions, which are caused by space deformations. The space interactions, which are predicted by the general relativity theory for any form of energy, appear the most evidently at an action of one energy form onto the other form. Such interaction, for example, accounts for an effect of electric potential generation by permanent magnetic field in electrolytes.

The mechanism of such effect is the next. Magnetic field causes a field of shear deformations for the space, i.e. creates a non-zero curvature in Euclidean space. These shear deformations act on the rotational component of the thermo-chemical Gibbs potential, which is created by thermal rotational motion of molecules.

Vectors of molecules angular velocities are situated along force lines of the magnetic field. The most of molecules in electrolyte has the same direction of these vectors as they rotate with the same direction. Therefore, the energy of space deformations, which is generated by the magnetic field, is added to the thermal energy at one pole but it is subtracted from the thermal energy at the other pole. Consequently, the rate of molecules dissociation onto ions is higher at one pole than at the other one. That leads to the higher concentration of ions near one of the poles.

Further, diffusion of ions to the other pole occurs. As more light ions move faster, it should be observed the higher concentration of heavy ions near one pole and lighter ions of the same sign near the other pole. That leads, in turn, to the appearance of electrical potential between the poles of the magnet.

Control of a weak information signal is not present here. However, in this case deformations of the space, which is generated by the magnetic field, are big enough to cause directly ponderable changes of Gibbs potential.

The equipment for observation of such effect is enough simple. Current non-conducting membranes, which are liquid-penetrable, are put on the poles of the permanent magnet. They are plastic nettings and electrodes from the same material are attached to them. The authors used stainless steel electrodes for that purpose. During immersion into electrolyte, the voltage difference is marked at the electrodes.

Nine-percent solution of C₂H₄O₂ was used as an electrolyte. Negative potential was registered at the north pole and, correspondingly, the positive one - at the south pole. In this case the space deformations are an intermediator during energy transfer from the
magnetic field to the thermal energy and back. Here, the thermal energy is spent that is a cause of appearance of the electrical potential.

Without the theory of space deformations it is difficult enough to explain the influence of the permanent magnetic field onto the motion of neutral molecules as well as the separation of the charges. Such permanent magnetic field only arranges the motion of ions along the force lines but according to the known theories it can not result in the separation of the charges and appearance of the electrical potential. However, the authors do not deny another theoretical explanation although they think that its probability is very small.

In the paper [7] the estimation of the interaction constant for the spatial field of thermo-chemical potential was obtained. It was $10^5$ times greater than the constant of gravitational interaction, which is usually taken into account in solving the problems of celestial mechanics for calculating trajectories of celestial bodies. However, such ratio between the energy of the spatial field of thermo-chemical potential and the energy of heat and mass transfer, especially at high temperatures, is not enough for the significant change of parameters of heat and mass transfer by direct energy transfer from the spatial field and back. Influence of the field of thermo-chemical potential has, as it was already noted, the informational nature. In the work [8] the experimental investigations are described, which explicitly enough verify the spatial influence of different materials on the process of crystallization in ice physical models with organic additives. However, these experimental investigations still need a wider statistical basis.

### 7 Conclusion

On the base of the constructed analogue of the equations of the general relativity theory out of formalism of Riemannian geometry, there were found the possibilities of the natural control of the energy material process at weak field information interactions. The physical effect together with the device for its observation is described, which partially justifies presence of some certain structure of the space and interaction of this structure with material energy processes.

### References:


