ISSN: 2578-7365

Research Article

Journal of Chemistry: Education Research and Practice

Digital Model of Mechanical Interaction and its Application

Iurii Teslia

Doctor of Engineering Science, Professor of the Department of Design Information Technologies of the Cherkasy State Technological University, Cherkasy, Ukraine

***Corresponding authors**
Iurii Teslia, Doctor of Engineering Science, Professor of the Department of Design Information Technologies of the Cherkasy State Technological University, Cherkasy, Ukraine.

Submitted: 24 Aug 2022; **Accepted**: 03 Sep 2022; **Published**: 23 Sep 2022

Citations: *Teslia, I. (2022). Digital Model of Mechanical Interaction and its Application. J Chem Edu Res Prac, 6(2),362-370.*

Abstract

A digital model of mechanical interaction is proposed, in which the motion of virtual objects in one-dimensional space is determined by their information content. The correspondence of the mathematical description of motion in the digital model to the physical laws is shown. Using a digital model of mechanical interaction, a method for calculating the reaction to the interaction in reflex intelligent systems is proposed. A brief description of the response to the interaction of reflex intelligent systems created using the method of calculation is given. Their effectiveness in solving problems of natural language communication, forecasting, management, expert evaluation, etc. is shown.

Keywords: Information Interaction, Reflex Systems, Digital Model of Mechanical Interaction, Method of Calculation of Reaction to Interaction

Introduction

Those who started working in IT in the 60s and 70s of 20th century remember analog computers well. They also remember analog TV, analog telephone, analog landline radio. Then the 21st century has come. And the term "digital" began to appear more and more often in the information space. Well, digital computers have been around for a long time. But digital television, digital communication, digital transformation, digitalization, etc. appeared relatively recently. It turned out that digital technologies are more efficient, more productive, simpler, have higher quality than analog.

As a development of these views, the aim of the work is to create a digital model of mechanical interaction and demonstrate its compliance with the processes of interaction at the level of human intellectual activity. After all, solving many problems in economics, management, production, the military, etc. related to the assessment of the impact of many factors on the relevant mechanisms and processes. The main idea of the work is to approach the solution of this problem by analogy with the processes of interaction in natural systems. After all, material objects are in constant mechanical interaction and "know how" to respond to many influences. Therefore, the creation of a digital model of mechanical interaction will allow the method of analogies to create responsive (reflex) intelligent systems that take into account the influence of many factors and form reactions by analogy with mechanical processes. Because today the problem of taking into account the assessment of the impact of many factors on final decisions remains relevant and not fully resolved. Especially if these factors have different physical nature, different measures, affect different elements of the studied system.

Materials and Methods

Where is the limit of digital technology? Is the use of numbers limited by human activity? Or not only? And digital technologies are available not only in artificial systems, but also in natural ones. Today there are a number of theories that declare a digital version of world formation. In particular, the hypothesis of computer simulation of Nick Bostrom, or the study of the physical laws of physics as a cellular automaton by Stephen Wolfram [1, 2]. Or the Digital Universe ideas, which are associated with the name of Nobel Prize laureate Gerard T. Hoft [3]. But, unfortunately, these theories have not received experimental confirmation.

The work is devoted to the issue of informational and probabilistic interpretation of mechanical movement [4]. This idea was developed in the work [5]. But the assumptions expressed in these works did not receive a formal representation. In particular, no mathematical model was built that would correspond to the information-probabilistic interpretation of mechanical movement. Therefore, for the further development of ideas related to the identity of non-force (information) interaction processes, it is necessary to build and prove the adequacy of the digital model of mechanical interaction to information processes in the human brain. When such adequacy is confirmed, it will make it possible to use the developed model to create applied information systems in many areas of human activity.

Theory

Digital Model of Mechanical Motion

The digital model contains virtual (computer) objects, which consist of a memory management program (random selection of 1 or 0 from its memory and its filling), as well as memory, which stores the values of 1 and 0. In each cycle of the digital motion model the program selects 1 or 0, with a probability that corresponds to the ratio of the amount of memory in which the value of 1 is stored, and the amount of memory in which the value of 0 is stored (Fig. 1). The physical interpretation of the values 1 and 0 is: 1 – movement in the direction of "1", 0 – movement in the direction of "0" (Fig. 1). Information (1, 0) is accumulated in the object memory during the process of interaction with other objects. This information essentially prompts the object to move.

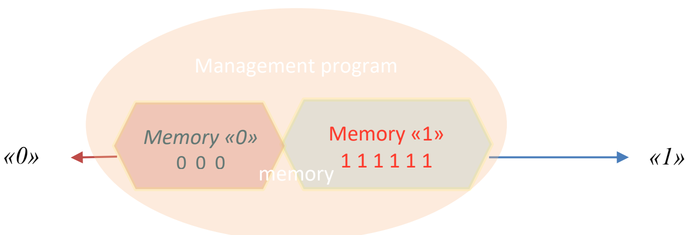

Figure 1: A Virtual Object Structure in a Mechanical Motion Digital Model

Definition 1. The difference in the amount of memory to store 1 and 0 is called the amount of information that encourages movement (or certainty), and it is denoted by *d*:

$$d = i_1 - i_0, \qquad (1)$$

where i_1 is the amount of memory containing 1 value; i_0 is the amount of memory containing 0 values; *d* is the amount of information that encourages movement.

Definition 2. The sum of the memory amounts to store both 1 and 0 is called awareness (the amount of object memory, its quantitative measure, denoted by *i*).

$$i = i_1 + i_0, \qquad (2)$$

where *i* is awareness – the amount of the object digital memory – its quantitative measure.

Rule 1. For different objects, the choice is statistically independent (the choice of 1 or 0 by one object does not depend on the choice of 1 or 0 by another object).

Rule 2. Two objects in one cycle of a digital model can implement the same choice (both 1 or both 0), or different (object A chose 1 and object B chose 0, or vice versa). Since the same choice means that the objects in this measure are the same (inseparable – it is impossible to find white paint on a white background), the interaction between them is impossible. They exist relative to each other (separated) and interact only in those cycles in which different choice is implemented.

Let's present the parameters of the digital model operation.

Probability of Choosing Values 1 And 0 with One Object

$$\mathrm{p}_1 = \frac{i_1}{i_1 + i_0}; \qquad (3)$$

$$\mathrm{p}_0 = \frac{i_0}{i_1 + i_0}, \qquad (4)$$

where p_1 – the probability of selecting the 1 value from memory; p_0 – the probability of selecting the 0 value from memory.

The Relative Advantage of Choosing the Values of One Object

$$\Delta = \frac{k_1 - k_0}{k_1 + k_0} \approx \frac{p_1 \cdot n - p_0 \cdot n}{p_1 \cdot n + p_0 \cdot n} = \frac{\dfrac{i_1}{i_1 + i_0} \cdot n - \dfrac{i_0}{i_1 + i_0} \cdot n}{\dfrac{\dfrac{i_1}{i_1 + i_0} \cdot n + \dfrac{i_0}{i_1 + i_0} \cdot n}{i_1 + i_0}} = \frac{i_1 - i_0}{i_1 + i_0} = \frac{d}{i}, \qquad (5)$$

where k_1 – number of times 1 was selected; k_0 – number of times 0 was selected; Δ – relative advantage of selecting 1 over selecting 0.

If Δ>0, then this indicates a greater amount of information that prompts choice 1. And vice versa, if Δ<0, then this indicates more information that prompts the choice of 0.

The Advantage of Choosing Some Object Over Another

It follows from rule 2 that if the observer is in object A and follows object B, it will see that object B chose 1 only when object A itself chose 0. And vice versa, from (5) follows, that the advantage of choosing 1 by some object, over choosing 1 by another object will be as follows:

$$\Delta_{AB} = \frac{k_{10} - k_{01}}{k_{10} + k_{01}} \approx \frac{p_1^A \cdot p_0^B \cdot n - p_1^B \cdot p_0^A \cdot n}{p_1^A \cdot p_0^B \cdot n + p_1^B \cdot p_0^A \cdot n} = \frac{p_1^A \cdot p_0^B - p_1^B \cdot p_0^A}{p_1^A \cdot p_0^B + p_1^B \cdot p_0^A} = \frac{d_{AB}}{i_{AB}}, \quad (6)$$

where k_{10} – how many times per time unit value 1 was selected by object A and value 0 was selected by object B; k_{01} – how many times per time unit value 0 was selected by object A and value 1 was selected by object B; p_1^A – the probability of selection with object A the value 1 from memory; p_1^B – the probability of selection with object B the value 1 from memory; p_0^A – the probability of selection with object A the value 0 from memory; p_0^B – the probability of selection with the object B the value 0 from memory; d_{AB} - the amount of information equivalent to the difference in the amount of information of objects A and B, i_{AB} – awareness, equivalent to the difference in awareness of objects A and B, n – the number of values selected by objects A and B per time unit; Δ_{AB} – the relative advantage of the value 1 selection with object B over the value 0 for the observer in object A.

The Ratio of the Memory Amounts of Two Or More Objects

From formula (6) it follows that for the observer the object A will select the same number of values 1 as object B values 0. Object B will select the same number of values 1 as object A values 0. And vice versa. Therefore, the relative amount of information that induces movement in the direction "1" of object A, relative to object B, will be the same as the relative amount of information that induces movement in the direction "0" of object B, relative to object A. And vice versa. Concerning the statistical independence of the choice, it is possible only if the ratio of memory sizes with a value 1 of objects A and B is directly opposite to the ratio of memory sizes with 0 value.

$$\frac{i_1^A}{i_1^B} = \frac{i_0^B}{i_0^A}.$$

From here

$$i_1^A \cdot i_0^A = i_1^B \cdot i_0^B = r = const.$$

And this is true for any pair of objects!

$$i_1 \cdot i_0 = r = const. \quad (7)$$

Information Amount and Awareness Values

These values depend on the amount of memory i_1 i i_0. Let's determine the relationship between the amount of information and awareness. From (7) it is possible to deduce

$$i_0 = \frac{r}{i_1}. \quad (8)$$

Using definitions (1), (2) and (8) a system of equations can be obtained,

$$\begin{cases} d = i_1 - i_0 = i_1 - \dfrac{r}{i_1} \\ i = i_1 + i_0 = i_1 + \dfrac{r}{i_1} \end{cases}.$$

So,

$$d = \pm\sqrt{i^2 - 4 \cdot r};$$

$$i = \sqrt{d^2 + 4 \cdot r}.$$

For the convenience of simulation r=0,25 was accepted. Then the relationship between the amount of information that motivates movement and awareness became

$$d = \pm\sqrt{i^2 - 1}; \quad (9)$$

$$i = \sqrt{d^2 + 1}. \quad (10)$$

And the relationship between the amount of information and the probability of choosing a value of 1 or 0 can be obtained from formulas (5) and (10). Taking in the formula (5)

$p_0 = 1 - p_1$,

it is possible to write

$$\frac{p_1 \cdot n - p_0 \cdot n}{p_1 \cdot n + p_0 \cdot n} = \frac{d}{i} \rightarrow 2 \cdot p_1 - 1 = \frac{d}{\sqrt{d^2 + 1}}.$$

Using (10) it is got

$$p_1 = 0{,}5 + \frac{d}{2 \cdot \sqrt{d^2 + 1}} = 0{,}5 + \frac{d}{2 \cdot i}. \quad (11)$$

Solving with respect to d we have

$$d = \frac{p_1 - 0{,}5}{\sqrt{p_1 \cdot (1 - p_1)}}. \quad (12)$$

The Difference in the Amount of Information in Two Objects

It seems that everything is simple. If consider two objects A and B, the difference in the amount of information is the arithmetic difference between d_A and d_B. But as follows from (6) this is not the case. The advantage of choosing 1 by one object over choosing 1 by another object (6) reflects the difference in the amount of information d_{AB}. Let's find it. From formula (11)

$$p_1^A = 0{,}5 + \frac{d^A}{2 \cdot i^A};\ p_0^A = 1 - p_1^A = 0{,}5 - \frac{d^A}{2 \cdot i^A}$$

$$p_1^B = 0{,}5 + \frac{d^B}{2 \cdot i^B};\ p_0^B = 1 - p_1^B = 0{,}5 - \frac{d^B}{2 \cdot i^B}$$

where d^A – the amount of information in object A; d^B – the amount of information in object B; i^A– object A awareness; i^B– object B awareness.

Let's substitute in (6)

$$\frac{\left(0{,}5 + \frac{d^A}{2 \cdot i^A}\right) \cdot \left(0{,}5 - \frac{d^B}{2 \cdot i^B}\right) - \left(0{,}5 + \frac{d^B}{2 \cdot i^B}\right) \cdot \left(0{,}5 - \frac{d^A}{2 \cdot i^A}\right)}{\left(0{,}5 + \frac{d^A}{2 \cdot i^A}\right) \cdot \left(0{,}5 - \frac{d^B}{2 \cdot i^B}\right) + \left(0{,}5 + \frac{d^B}{2 \cdot i^B}\right) \cdot \left(0{,}5 - \frac{d^A}{2 \cdot i^A}\right)} = \frac{d_{AB}}{i_{AB}}.$$

Let's use (10). Then

$$\frac{\left(0{,}5 + \frac{d^A}{2 \cdot i^A}\right) \cdot \left(0{,}5 - \frac{d^B}{2 \cdot i^B}\right) - \left(0{,}5 + \frac{d^B}{2 \cdot i^B}\right) \cdot \left(0{,}5 - \frac{d^A}{2 \cdot i^A}\right)}{\left(0{,}5 + \frac{d^A}{2 \cdot i^A}\right) \cdot \left(0{,}5 - \frac{d^B}{2 \cdot i^B}\right) + \left(0{,}5 + \frac{d^B}{2 \cdot i^B}\right) \cdot \left(0{,}5 - \frac{d^A}{2 \cdot i^A}\right)} = \frac{d_{AB}}{\sqrt{d_{AB}^2 + 1}}.$$

Having solved this, we get

$$\mathrm{d}_{AB} = d^A \cdot i^B - d^B \cdot i^A. \quad (13)$$

Changing the Amount of Memory

The amount of digital memory changes under the influence of other objects. If the object mechanically interacts with another object in which the amount of memory in which 1 is stored is greater, then the amount of the current object memory in which 1 is stored increases, and the amount of memory in which 0 is stored decreases. In another object it is the opposite. This is how gravity is modelled. If another object is in the "0" direction, the amount of memory in which 1 is stored decreases and the amount of memory in which 0 is stored increases. In another object it is the opposite.

Maximum and Minimum Relative Advantage of Values Selection

It follows from formula (5) that the maximum and minimum relative advantage of values selection corresponds to zero memory of some values, and not zero memory of other values.

So, for $i_0 = 0$ and $i_1 > 0$ we get

$$\Delta = \frac{i_1 - i_0}{i_1 + i_0} = \frac{i_1}{i_1} = 1. \quad (14)$$

For $i_1=0$ i $i_0 > 0$ we get

$$\Delta = \frac{i_1 - i_0}{i_1 + i_0} = \frac{-i_0}{i_0} = -1. \quad (15)$$

In order to move from a digital model of mechanical motion to a digital model of mechanical interaction, it is necessary to interpret the attributes of this model with physical parameters, and by analogy with the laws of mechanical interaction to obtain formulas for changing the information content of virtual objects. That will create a method of responding to interaction in applied intelligent systems. To do this, we assume that in Nature the movement is realized exactly as it was presented in the digital model [4].

Mechanical Motion in a Digital Model

Physical Interpretation of Digital Motion Model

1. Since the values 1/0 are produced in each cycle in the model, let this cycle corresponds to the quantum of time equal to Planck's time: t=5.39121×10^{-44} s. And displacement quantum (motion unit) corresponds to Planck's distance l_p=1,61624 10^{-35} m.
2. Let's assume that generating a value of 1 by a digital object will correspond to moving by 1 quantum of space along the motion vector, and generating a value of 0 by moving by 1 quantum of space in the direction opposite to the motion vector.
3. In each quantum of time, one quantum of move in space is produced. Therefore, all objects move with a single speed $\vec{c}$. After all

$$\vec{c} = t_p \cdot l_p, \quad (16)$$

where $\vec{c}$ is the movement speed in a digital model (speed of light in vacuum).

4. As soon as a digital object produces two values (1 and 0) that correspond to a displacement of 1 quantum of space in two directions, it will drift in the direction that corresponds to the more probable value. Drift speed is the speed of an object that can be recorded by an observer.

From formulas (5) and (16) the expected drift velocity of the object in the direction of motion

$$\vec{v} = \Delta \cdot \vec{c}, \quad (17)$$

where $\vec{v}$ - expected drift speed – speed of movement.

In formula (17) let's represent Δ through the amount of information and awareness (5). The following is received

$$\vec{v} = \frac{d}{i} \cdot \vec{c}, \quad (18)$$

where $\vec{v}$ is the drift velocity of the object in the motion direction.

If the object does not move ($\vec{v}$ = 0, absolutely or relatively), then from (18)

$$d = \frac{\vec{v} \cdot i}{\vec{c}} \rightarrow d = 0. \quad (19)$$

From (10)

$$i = \sqrt{d^2 + 1} \rightarrow i = 1. \quad (20)$$

From the digital model of mechanical motion, it is possible to get an explanation why the speed of light in vacuum is maximum and absolute. Let's consider this issue.

Speed of Light in Vacuum

The Maximum Speed of Light in Vacuum

From (14) and (17)

$$\vec{v} = \Delta \cdot \vec{c} = 1 \cdot \vec{c} = \vec{c}.$$

From (15) and (17)

$$\vec{v} = \Delta \cdot \vec{c} = -1 \cdot \vec{c} = -\vec{c}.$$

The maximum speed of movement is the speed of light in vacuum, because it corresponds to a one-way movement with a probability of 1.

Absolute Speed of Light in Vacuum

The speed of light in vacuum corresponds to the choice of only 1, or only 0. And other objects "observe" such light only when choosing a different value (0 or 1, respectively). Indeed, from (6) and (17) for two objects A and B the relative velocity $\vec{v}_{AB}$ will be equal to:

a) $p_1^B = 1, p_0^B = 0, 0 < p_1^A < 1,\ 0 < p_0^A < 1 : \vec{v}_{AB} = \Delta_{AB} \cdot \vec{c} = \frac{p_1^A \cdot p_0^B - p_1^B \cdot p_0^A}{p_1^A \cdot p_0^B + p_1^B \cdot p_0^A} \cdot \vec{c} = \frac{-p_0^A}{p_0^A} \cdot \vec{c} = -\vec{c};$

b) $p_1^B = 0, p_0^B = 1, 0 < p_1^A < 1,\ 0 < p_0^A < 1 :: \vec{v}_{AB} = \Delta_{AB} \cdot \vec{c} = \frac{p_1^A \cdot p_0^B - p_1^B \cdot p_0^A}{p_1^A \cdot p_0^B + p_1^B \cdot p_0^A} \cdot \vec{c} = \frac{p_0^A}{p_0^A} \cdot \vec{c} = \vec{c};$

As can be seen from these formulas, for an observer in object A drifting at any speed that is less than the speed of light in vacuum, the speed of object B drifting in the speed of light in vacuum will always be equal to the speed of light in vacuum.

Now let's consider the physical embodiment of the parameters entered into the digital model.

Relationship Between Physical Quantities and Parameters of a Digital Model

Awareness. From formulas (9) and (18)

$$\vec{v} = \frac{d}{i} \cdot \vec{c} \rightarrow i = \frac{\pm\sqrt{i^2 - 1}}{\vec{v}} \cdot \vec{c}.$$

Let's solve it with corresponding to i. It is received

$$i = \frac{1}{\sqrt{1 - \frac{\vec{v}^2}{\vec{c}^2}}}. \quad (21)$$

It is Lorentz coefficient! It turns out that the awareness of a digital object is equal to the Lorentz coefficient!

Formulas for relativistic mass and time has a simple form

$$m = \frac{m_0}{\sqrt{1 - \frac{\vec{v}^2}{\vec{c}^2}}} = m_0 i,$$

where m_0 is the object mass at rest (which corresponds to zero amount of information that encourages movement), m is the relativistic mass of the object.

$$t = \frac{t_0}{\sqrt{1 - \frac{\vec{v}^2}{\vec{c}^2}}} = t_0 i,$$

where t_0 is the time of the object at rest (which corresponds to zero amount of information that encourages movement), t is the relativistic time of the object.

The Amount of Information that Encourages Movement. From formulas (18) and (21)

$$\vec{v} = \frac{d}{i} \cdot \vec{c} \rightarrow d = \frac{\vec{v} \cdot i}{\vec{c}} = \frac{\vec{v}}{\vec{c}\sqrt{1 - \frac{\vec{v}^2}{\vec{c}^2}}}. \quad (22)$$

The physical embodiment of this quantity is impulse. Indeed, if we write the formula for the impulse taking into account the relativistic mass

$$\vec{P} = m\vec{v} = \frac{m_0 \cdot \vec{v}}{\sqrt{1 - \frac{\vec{v}^2}{\vec{c}^2}}}. \quad (23)$$

Combining formulas (22) and (23) it is obtained

$$d = \frac{\vec{P}}{m_0 \cdot \vec{c}}. \quad (24)$$

Or

$$\vec{P} = m_0 \cdot \vec{c} \cdot d. \quad (25)$$

Impulse is the amount of information that motivates movement, adjusted for the speed of light. From the law of impulse saving follows the law of information saving in a closed system. Indeed, if in a closed system

$$\sum \vec{P} = const,$$

then from formula (25) it follows

$$\sum_j m_{0j} \cdot \vec{c} \cdot d_j = const,$$

where m_{0j} is the object mass R_j at rest; d_j– the amount of information in object R_j.

Since $\vec{c}$ is a constant and m_{0j} can be represented by the number of digital objects R_j, it is possible to write

$$\sum_j \sum_{i=1}^{m_{0j}} d_j = const. \quad (26)$$

Physical Manifestation of the Difference in the Amount of Information in Two Objects. From formulas (13), (18) and (19)

$$\frac{\vec{v}_{AB}}{\vec{c}} \cdot \frac{1}{\sqrt{1 - \frac{\vec{v}_{AB}^2}{\vec{c}^2}}} = \frac{\vec{v}_A}{\vec{c}\sqrt{1 - \frac{\vec{v}_A^2}{\vec{c}^2}}} \cdot \frac{1}{\sqrt{1 - \frac{\vec{v}_B^2}{\vec{c}^2}}} - \frac{\vec{v}_B}{\vec{c}\sqrt{1 - \frac{\vec{v}_B^2}{\vec{c}^2}}} \cdot \frac{1}{\sqrt{1 - \frac{\vec{v}_A^2}{\vec{c}^2}}}.$$

Having solved it we get

$$\vec{v}_{AB} = \frac{\vec{v}_A - \vec{v}_B}{1 - \frac{\vec{v}_A \cdot \vec{v}_B}{\vec{c}^2}}.$$

This is the formula of relativistic addition of velocities known from the special theory of relativity.

These calculations do not mean that there is evidence that the proposed model is the basis of mechanical motion. But this means that this model may be the basis of mechanical motion.

If we assume that the mechanical motion is realized in accordance with the proposed digital model, we can make one assumption. First, matter was created, in the memory of which there was nothing, there was no "program" of response to influences, which "knew nothing", but in the process of development learned, became such as to satisfy some criterion. And the laws of velocity change in interaction, as well as various physical constants related to motion and interaction are the result of matter "learning". It is the information stored in digital memory and the program that processes the memory that is tuned to the "correct" response that determines the response that we perceive as the result of physical laws. Today, the "right reaction" is reflected in various physical constants.

Method of Calculating the Reaction to the Interaction

Using the law of momentum conservation, the reaction of material objects to mechanical interaction can be calculated in a digital model. In the event of a collision:

1. The speed of movement of material objects changes.
2. So changes in certainty and awareness (from formulas 9, 10 and 18).
3. From this we can obtain formulas for calculating the reaction to the interaction.

To obtain these formulas, the process of direct interaction of material objects was considered, the motion after the collision of which is subject to the law of impulse saving. And if in section 5 for the parameters of the digital model their physical embodiment was determined, then in this case it is necessary to act in the opposite direction. Knowing how the speed of material objects changes when they collide, it is necessary to develop a method of calculating the information content of digital objects in their non-force (informational) interaction. The starting point of this method will be the relationship between the amount of information and the speed of the object. If the speed has changed after the collision, then the amount of information that motivates the movement of this object has also changed.

The following problem statement was proposed. An experiment is taken. Object x_i collided with object A moving at speed $\overrightarrow{\upsilon(A)}$ After the collision, the velocity of object A became $\overrightarrow{\upsilon(A/x_i)}$. Then the object A was again given the velocity $\overrightarrow{\upsilon(A)}$, after that it collided with the object x_j. After the collision, the velocity of object A became $\overrightarrow{\upsilon(A/x_j)}$. It is necessary to find the velocity of object A after the collision with both objects x_i and x_j (υ $\overrightarrow{\upsilon(A/x_i\, x_j)}$ under the same initial conditions (initial velocities of objects x_i and x_j).

In physics, this problem has a solution. Based on this statement of the problem and its physical solution, a method for calculating the reaction to the interaction was developed [4-6]. The essence of this method is given in table 1.

Table 1: Scheme of the Method for Calculating the Reaction to the Interaction Implementation

Stage	Procedure	Formula #	Physical essence	Physical formula
1	Being based on the unconditional probability of an event *p(A)* the amount of information that encourages this event is calculated $d(A) = (p(A) - 0{,}5)/\sqrt{p(A)\cdot(1-p(A))}$	(12)	The initial speed of the object A.	
2	Being based on the unconditional probability of an event after influence $x_i p(A/x_i)$ new amount of information which encourages this event is calculated $d(A/x_i) = (p(A/x_i) - 0{,}5)/\sqrt{p(A/x_i)\cdot(1-p(A/x_i))}$	(12)	Speed of the object A after colliding with object xi.	
3	Calculation of influence xi on the event *A* $\Delta d(A/x_i) = d(A/x_i)\cdot\sqrt{d^2(A)+1} - d(A)\cdot\sqrt{d^2(A/x_i)+1}$	(13)	The difference in the speed of object A after and before the collision with the object x_i	Relativistic addition of velocities
4	Total impact on the event *A* $\Delta d(A/X) = \sum_{x_i\in X}\Delta d(A/x_i)$	(26)	The difference in the speed of object A after and before the collision with all objects	Impulse
5	A new amount of information (after all the influences) that motivates the event *A* $d(A/X) = d(A)\cdot\sqrt{\left(\Delta d(A/X)\right)^2+1} + \Delta d(A/X)\cdot\sqrt{d^2(A)+1}$	(13)	New speed of object A after collision with all object	Relativistic addition of velocities

Notation in table 1: p(A) – unconditional probability of event A; $p(A/x_i)$ – probability of event A after influence x_i; d(A) – the initial (before influences) amount of information that motivated event A; $d(A/x_i)$ – the amount of information that motivates event A after influence x_i; $\Delta d(A/x_i)$ – the magnitude influence xi on event A; Δd(A/X) – the total influence on event A, d(A/X) – the new amount of information (after all influences) that motivates event A.

The method allows for some set of alternative events $A=\{a_j\}, j=\overline{1,m}$ and influences on this event $X=\{x_i\}, i=\overline{1,n}$, by unconditional $p(a_j), j=\overline{1,m}$ and some conditional probabilities of the event $p(a_j/x_i), j=\overline{1,m}, i=\overline{1,n}$, estimate the amount of information that will form each of the events a_j, when all the effects will be realized – $d(a_j/X)$ (by analogy with the speed of the object after mechanical interaction with others). And then base the behavior on the assumption that the event about which the most information is, will occur more likely than others. Moreover, it does not matter what type of input effects. It can be both visual images, and human speech, and air temperature, etc.

Results

The first part of the goal of the work has been achieved by the preliminary presentation - a digital model of mechanical interaction has been built. The basis of the model is the transition from operating with physical categories (speed, momentum) to informational categories. This allows us to move on to using the model in informatics. But for this, it is necessary to demonstrate the correspondence of the obtained model to the information processes in the human brain.

Experimental Verification of the Digital Model

The domain for experimental research was human language. The experiments investigated the question of whether the actual probabilities of the appearance of text fragments correspond to the probabilities calculated using the method of calculating the reaction to the interaction. In other words - whether the proposed digital model of human speech mechanism is adequate.

Language is formed by the information processes of our brain. And what if the interaction of neurons in these processes also occurs in accordance with the obtained formulas for handling information?

In the experiments, texts in English, German, Russian, and Ukrainian were selected [7]. It turned out that the method of calculating the reaction to the interaction allowed to predict with great accuracy the appearance of certain fragments of the text. Moreover, the method of calculating the reaction to the interaction was compared with other methods. The method of calculating the reaction to the interaction showed the best result by all criteria, for all texts and tasks (calculate the probability, make a prediction, rank) [7].

The encouraging results of the experiments allowed us to proceed to the creation of applied systems based on the proposed digital model of mechanical interaction.

Practical Implementation of the Digital Model

Using the method of calculating the reaction to the interaction, a number of reflex intelligent systems were created, which solved various problems [5, 8]. To date, the following systems have been created: forecasting the results of sports games, evaluating investment proposals, accessing databases in natural language, automatic message forwarding, voice control of TV and telephone, etc [6, 9-13]. The main advantage of these systems is not even that they are more efficient than others, but that the cost of their development is minimal. As shown in these experiments and practical developments, the method allows you to choose the right reactions in different subject areas in 99% of cases.

The last example is the UM system for forecasting the results of sports games [9, 10]. In the summer of 2021, the European Football Championship 2020 took place. Before the games of the 1/8 finals, the forecasts of artificial intelligence (Stats Perform), the UM system, which was created using the method of calculating the reaction to the interaction, the analytical center KU Leuven and experts of bookmakers were published [10, 14-17]. The forecast was the probability of passing the teams in the next stages and winning the championship. At the end of the championship, the standard deviation of the forecast (probability of passing) from the fact of passing the team to the next stage was calculated. The results were: analytical center – 0.5278; artificial intelligence – 0.498294; bookmakers – 0.489042; **UM system – 0.464156** [10]. The best was the system that used the method of calculating the reaction to the interaction [9, 10].

Discussion

The proposed digital model demonstrates the possibility of creating a virtual world in which the movement of objects is determined by their information content. At the same time, there will be no difference between the movement of objects in the virtual world (change of direction and speed during interaction) and mechanical movement in the real world. This leads to the main debatable question of the work - isn't information also at the basis of mechanical movement in our Nature? As it is represented in the digital model. Experiments and practical results, at least, confirm that the laws of mechanical interaction correlate with the laws of informational interaction at the human level. And it is very likely that the laws of mechanical interaction have a more general nature than just physical laws. Although this issue is still debatable, the benefits of the built model are already there. This is evidenced by the practical results of the creation and use of reflective intelligent systems.

Conclusion

The main scientific result of the work is a digital model of mechanical interaction, which provides an informative interpretation of mechanical movement. Laws of mechanical interaction reflected in the digital model allowed to create a number of effective responsive to interaction (reflex) intelligent systems that successfully solve applied problems in the field of automation of human activities. The adequacy of the developed digital model to human speech processes was confirmed in experiments. At the very least, this model is already useful because it can be used to build simple and effective reflective intelligent systems, which do not care what information is simultaneously input - human language, visual images, sensor readings, or something else. The results of experiments and practical results slightly increase the probability that this model is still the basis of mechanical interaction.

References

1. Bostrom, N. (2003). Are we living in a computer simulation?. The philosophical quarterly, 53(211), 243-255.
2. Wolfram, Stephen. (2002). A New Kind of Science.
3. t Hooft, G. (2016). The cellular automaton interpretation of quantum mechanics (p. 298). Springer Nature.
4. Klapchenko, V. I., & Teslya, Y. M. (2011). Probabilistic interpretation of mechanical motion.
5. Teslia, I. (2014). Non-forceful Nature: monograph. Чабаненко ЮА.
6. Teslia, I., Popovych, N., Pylypenko, V., & Chornyi, O. (2014, March). The Non-force interaction theory for reflex system creation with application to TV voice control. In Proceedings of the 6th International Conference on Agents and Artificial Intelligence, ESEO, Angers, Loire Valley, France-Volume 1: ICAART (pp. 288-296). Proceedings of the 6th International

Conference on Agents and Artificial Intelligence, ESEO, Angers, Loire Valley, France-Volume 1: ICAART.
7. Teslia, I. (2022). Experimental Verification of the Theory of Non-Force (Information) Interaction. Journal of Modern Physics, 13, 518-573.
8. Teslia, I. M., Yehorchenkov, O. (2018a). Certificate №81829 on registration of copyright to the work, 27.09.2018, computer program "Reflex Intelligent System".
9. Teslia, I. M., Yehorchenkov, O., Khlevna, I., Kataieva, Y., Khlevnyi, A. (2021a). Using the Reflex Method to Predict the Results of Football Matches. Information technologies and computer modelling - materials of the International scientific-practical conference, Ivano-Frankivsk, 106–107.
10. Teslia, I. M., Khlevna, I., Yehorchenkov, O., Zaspa, H., Kataieva, Y., Khlevnyi, A. (2021b). Reflective intelligent system UM and its application for forecasting the 2020 European Football Championship Results. INFORMATION SYSTEMS AND TECHNOLOGIES IST-2021 Proceedings of the 10-th International Scientific and Technical Conference, Kharkiv, Ukraine, 279-282.
11. Teslia Yu. M. (2011). Formation and analysis of decision making to evaluate investments in development projects./Yu. Teslia, P. Kayuk, M. Chernova/Management of complex system development.–№, 60-62.
12. Teslia, I. (1998). Reactive system of processing natural language texts in automated command and control system of the construction of complex power plants. Radioelectronics and information science, 4, 52-55.
13. Teslia, I. M., Kubiavka, L., Kubiavka, M., Pampukha, I., Savran, V., Sokolov, K., Vishchun V., Loza, V. (2018b). Patent for a utility model "Device for automatic targeted distribution of messages to the final recipient". №130673.
14. Artificial Intelligence called the chances of the Ukrainian national team to pass Sweden in the 1/8th final. (2021a).
15. Let's go to football. (2021c).
16. Fomichev, M. (2021). Who will win Euro 2020? France is the favorite ahead of the playoffs.
17. Bets and odds for Euro 2020. (2021b).