The challenging concept of Newtonian mechanics from philosophical view

Mehdi Jafari Matehkolaee[1], **Shayan Khorasani**[2]
[1] *Sama technical and vocational training college, Islamic Azad University, Sari Branch, Sari, Iran.*
[2] *F Shahid Beheshti High School, Sari, Mazandaran, Iran.*

E-mail:mehdiariamehr@gmail.com, khorasanishayan@gmail.com

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Abstract

We present a brief description from Newton's theory that containing profound points. Afterward we show that based on the diverse philosophical concepts this theory could be contestable.

Resumen

Se presenta una breve descripción de la teoría de Newton que contiene puntos de reflexión profundos. Después nos muestran que en base a los diversos conceptos filosóficos esta teoría podría ser discutible

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I. INTRODUCCIÓN

Now, it is more than 300 years that newtonian mechanics is accepted as one of the fundamental branches in physics science. Many phenomena in macroscopic dimension can be explained indisputably. Even in relativity, newtonian time conception is confirmed and the only thing that changes is manner of measurement. Also in quantum mechanics many structures and mathematical patterns has extracted of Newtonian mechanics. If we don't consider relativity and quantum mechanics then, in the same macroscopic world, there are different reasons that indicate newtonian mechanics is containing of arguments so that can be contestable.

Physicists at the end of 19^{th} century reached the consensus that the relation $F=ma$ was just a definition, because the only quantity that can be measured unambiguously is the acceleration [1, 2].

Some researchers have performed in the attention to modify Newton's second law and experimentally test for it [3, 4, 5, 6]. First we should point that, although structural engineering science and relief progresses of it is based on the newtonian dynamics but many before 17^{th} century have constructed magnificent buildings that complexity and fragility have done in them are witness violence of builders on the construction science. In addition to this, what we are reading in kinematics and dynamics was evaluating as natural science and was proving in philosophical debates with more qualitative cases, which were forgotten because of emergence of some people such as Galileo and Newton so that substituted by quantitative laws.

We hold that former philosophers such as Aristotle, Philoponus, and Avicenna, Descartes paved the way for newtonian mechanics. To emerge our ancestors contribution and noticeable works into of to-day science have tried in many literatures. For example Avicenna, Persian physician and philosopher, was one of the greatest science philosophers in the history. Today, his contribution in projectile motion [7] and dynamics [8] is clear. In any case, Newton's theory is using as a powerful theory whether touched of his ancestors or considerable works that he did in his contemporary. We know that even the principle of least action that we can conclude Newton's second law from it, is a strong confirmed for Newton's theory. However, there are some debates that with respect to them, this theory can be contestable.

II. NEWTON'S THEORY IN A GLANCE

Before Newton, Avicenna has presented an important philosophical conception which is the dualism between subject and object. Also, Descartes tried to algebraic geometry and definition coordinates and they prepared conditions for Newton's theory [9]. Since both of these cases (dualism and algebraic geometry) do use in newtonian mechanics. For example in classical mechanics we consider physical parameters belong to body as objective qualities. There is one question once more: do object's geometrical dimensions have impressive contribution in this view? Avicenna held that object's geometrical dimensions influence on the celerity and sluggishness, but Jean Buridan didn't accept that.

In any case, we conclude of differential form of Newton's second law that force is an instantly-pointy quantity. When we set F on the system contain of n bodies so that all of them have the same acceleration such as following Figure 1, then we consider them as a point inattentive to their geometrical dimensions.

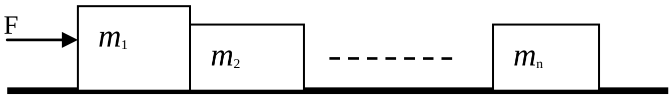

FIGURE 1. In this figure see inumerable objects at the firictionless surface.

Since in Figure 1 the horizontal surface is frictionless, then we can write:

$$F = (m_1 + m_2 + \cdots m_n)a. \quad (1)$$

Relation 1 shows that the set of bodies $(m_1, m_2, \ldots, m_n)$ are similar to a point (center of mass) so that in moment of *t*, *F* set on it.

Obviously, dimension of objects has no contribution in relation 1. Now, let us to investigate reductionism in this argument. We know newtonian mechanics is corresponding with reductionism philosophical view. Based on this view, analysis behavior of parts of a system is equivalent to total of system and the total have nothing more than set of parts.

If we want to write an equation for objects in Figure 1 according to reductionism, then at first we should state that F only set on m_1.

Next, by writing Newton's second law in horizontal direction for each one of them and combine these equations, led to Equation 1.

The analysis being in textbooks, free-body diagram is compatible with reductionism. When can we write a general equation directly similar relation 1 for a system formed with many bodies?

The answer is clear. This is true when all of the bodies have the same acceleration. But if we return to differential form of Newton's second law, we will found an important point. Although, force set in the point of space and instant of time, but force is a curvature in the space-time diagram. The amount of this curvature gets the following relation [10].

$$k = \frac{|\vec{V} \times \vec{F}|}{m|\vec{V}|^2} \quad . \quad (2)$$

Perhaps in the reductionism analysis full definition from Newton's second law is as following:

The ratio of result of forces that set on the system directly and from out of system, than mass of the system is equal to its acceleration.

In this definition system is the set of the objects so that all of them have the same acceleration.

In Newtonian mechanics position and velocity are the two dynamical variables so that connect each other with time.

Position as function of time gets the equation of motion.

The reasons of motion of physical objects are described by the metaphysical conception of force, directly.

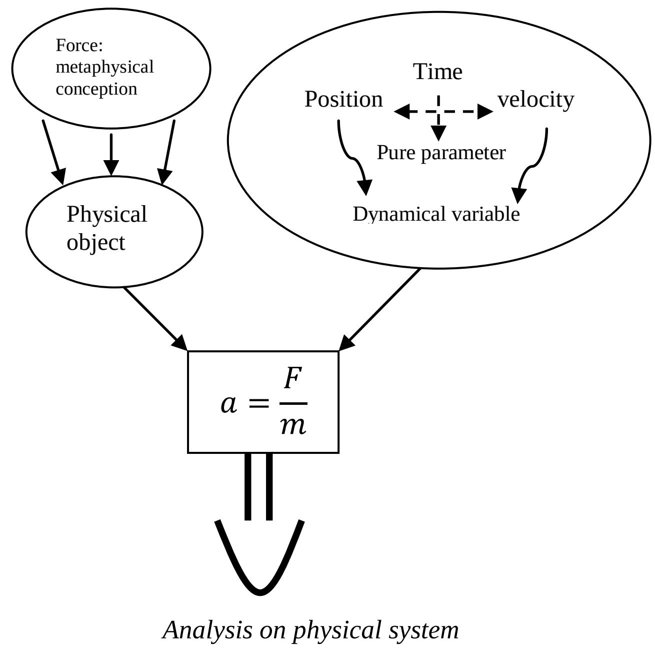

FIGURE 2. A general schematic of analysis object's motion.

The left part of the diagram shows dynamical analysis, and the other part represents kinematical analysis, so that both of them are consistent with each other.

III. NEWTON'S THEORY IN CHALLENGE

The most important supporter of Newton's principle is experiment and observation. If F doesn't insert to m_1 in Figure 1, we have to assume that there is no force between objects. In fact in this situation, although the objects have contact with each other but they don't have any interaction.

Indeed, generally, we can know the interaction between two objects when, we enter a force to one of them. In matter fact, to know the situation of a distinguished physical system, our interference is necessary for measuring in system.

Sometimes, necessity of our interference will be so further up, especially in cases that we have to use the concept of virtual forces. For example, consider a person in an elevator and there is an object at rest on floor of the elevator.

If the elevator doesn't move, the person will attribute the following relation:

$$N = mg. \quad (3)$$

That N is the force which the floor of the elevator inserts to object and mg is the weight of it. Now imagine that the elevator has ascending motion with constant acceleration a.

The person see object at rest again but for that reason Newton's theory has to hold then he must consider following equation:

$$N - mg - ma = 0. \tag{4}$$

Where ma is virtual force so that is downward. However, the main question is remained that what amounts can interference the awareness of person? Which criterion is there for that?

In Newton's second law, external forces are the causes of motion. When we survey the changing of a physical system by external causes around it, the main problem is the force itself. That is to say the force doesn't have a diagnostic metaphysical concept. Indeed, the forces are understood by Newton's second law principle. In many dynamical problems, acceleration of a physical system ascertains the incoming forces (for an instance in machines of Atwood, first we calculate the acceleration of objects then we calculate the tension of string).

We know that force can be a function of position, velocity and time

$$\vec{F} = \vec{F}(\vec{x}, \vec{v}, t)\ . \tag{5}$$

Suppose we want to propose an equation like Newton did.

But this time, the equation is more general:

$$\vec{F}_{(n)} = \frac{md^n\vec{r}_{(n)}}{dt^n}. \tag{6}$$

So that $\vec{F}_{(n)}$ can be like the following equation:

$$\vec{F}_{(n)} = \vec{F}_{(n)}\left(\vec{r}, \frac{d\vec{r}}{dt}, \ldots, \frac{d^{n-1}\vec{r}_{(t)}}{d\vec{r}^{n-1}}\right). \tag{7}$$

It's worthy of attention that in state *n*=2 and considering $\vec{F}_{(2)}\left(\vec{r}, \frac{d\vec{r}}{dt}, t\right)$ like Newton's force, the proposed equation will be Newton's equation. Relation 6 is important because force can be a function of acceleration, jerk and…while that is function of position, velocity and time. Here there is a problem similar to 19th century physicists yet, because mass parameter plays the same contribution. Now without this matter we will try to distinguish. What that substitute in *F*(*n*).

But a pre-proposition is necessary. This pre-proposition holds the theory of Newton. We derivative *n*-2 times of forces that is correct in Newton's relation, for $\vec{F}_{(n)}$.

$$\vec{F}_{(n)}\left(\vec{r}, \frac{d\vec{r}}{dt}, \ldots, \frac{d^{n-1}\vec{r}}{dt^{n-1}}, t\right) = \frac{d^{n-2}}{dt^{n-2}}\left(\vec{F}_{(2)}\left(\vec{r}, \frac{d\vec{r}}{dt}, t\right)\right). \tag{8}$$

Note that by each time integration the constant value adds to equation that we can face it by a method, which cause the last answer be Newton's equation. Of course this matter is correct when the force doesn't have a metaphysical concept.

For an instance in free fall we have:

$$-mg = \frac{md^2\vec{r}}{dt^2}. \tag{9}$$

So:

$$\rightarrow \frac{d^3\vec{r}}{dt^3} = 0 \rightarrow \frac{d^2\vec{r}}{dt^2} = -g.$$

How do we know a force with metaphysical concept, amount of $\frac{d^3\vec{r}}{dt^3}$ is equal to zero? We need for finding the solution of an n^{th} differential equation, n constants that are called integration constant and (*n*-1) times derivative at the initial point. With respect to newtonian mechanics, initial position (x_0) and its first derivative (v_0) are not determined and they can change, but other derivatives (second derivative or initial acceleration, third derivative are distinguished. The first comment for proposed equation is state $n = 1$.

$$\vec{F}_{(1)}(\vec{r}, t) = m\vec{v}. \tag{10}$$

Indeed by one time integration from Newton's equation we have:

$$\vec{F}_{(1)} = \int \vec{F}_{(2)} dt. \tag{11}$$

The first objection to this equation is that as we said, we can change v_0 and x_0 at pleasure in special conditions and its follower, momentum (mv) isn't able to appoint with an equation like relation (11).

$$\vec{F}_{(1)}(\vec{x}_0, 0) = m\vec{v}_0. \tag{12}$$

And the second objection is that $\vec{F}_{(n)}$ had to show the effect of the object's perimeter environment but, it's obvious that $\vec{F}_{(1)}$ looks unintelligible in the conditions like encountering.

We know in Newtonian mechanics, position of a system could not have leap as a function of time. But velocity can have leap in fast and sudden encountering. For example, consider a motionless object which in instant of zero takes v_0 by a sudden encountering and thereafter continues with v_0 without any obstacle.

$$\vec{F}_{(1)\,(t)} = \begin{pmatrix} 0 & t < 0 \\ mv_0 & t \geq 0 \end{pmatrix}. \tag{13}$$

It means that the object doesn't fell anything from the stroke till before encountering and thereafter it receives effect from environment forever! As we know $\vec{F}_{(1)}$, is object's linear momentum. It means that it's an attribute for it, not something which tells us the environment's effect. About zeroth state should say that

$$\vec{F}_{(0)}(\vec{r}, t) = m\vec{r}_{(t)}. \tag{14}$$

It means that we can know the position of object, when we know where is it!!

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