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Inertia Falsifies Newtonian Dynamics

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ABSTRACT

There are some obstacles in Newtonian dynamics that are still unresolved. Those obstacles are caused by both of the wrong understanding of inertia and the limitations in Newton's first & second laws. Therefore, I theoretically analyzed the motion of the spherical inelastic object on a perfectly smooth horizontal surface in a vacuumed system. I hypothesized two new laws in dynamics and a new physical property of forces which is "Force Relative Speed (FRS)" to explain the unexpected motion of the object and the flaws in Newton's dynamics. Also, I presented a new definition of inertia and showed why and when this new definition should be used. According to the dynamics that I introduced in this article, Newtonian physics cannot describe any object's motion when that object has inertia, therefore the motion of many objects in nature is misunderstood. Consequently, a lot of physical parameters that were measured by using Newtonian dynamics are not accurate.

KEYWORDS: Inertia, Motion, Newton's laws, Forces, Statics

INTRODUCTION

Inertia was first introduced by Galileo in his principle of inertial motion. Galileo's principle of inertial motion states that a body will remain in a state of motion as long as it is not interfered with by an external force [1]. Later on, Newton defined inertia in a way that is applicable to rest and motion. Newton defined inertia in his principia as:

"The vis insita, or innate force of matter, is a power of resisting by which everybody, as much as in it lies, continues in its present state, whether it be of rest or of moving uniformly forwards in a right line." [2]

That means, "Inertia" is the resistance of any object to any change in its state of motion including a change in direction, or it is the tendency of moving objects to keep moving in a straight line at a constant linear velocity.
Dynamics is the branch of mechanics that deals with the laws of motion [3]. Newtonian dynamics was established by Sir Isaac Newton in his work "Philosophiae Naturalis Principia Mathematica" which was first published in 1687, and it is commonly referred to as the "Principia". Newton's dynamics is based on his three laws of motion. Newton's first law of motion is commonly referred to as the "Law of Inertia" and states:

"Every body continues in its state of rest, or of uniform motion in a right line, unless it is compelled to change that state by forces impressed upon it." [2]

In modern language, Newton's first law states that an object at rest will stay at rest and an object in motion will stay in motion unless acted upon by a net unbalanced force.
Newton's second law tells us the relationship between the force that we exert or apply on the object and the resulting acceleration the object will gain and states:

"The change of motion is proportional to the motive force impressed; and is made in the direction of the right line in which that force is impressed." [2]

In modern language, Newton's second law states: "The acceleration of an object as produced by a net force F is directly proportional to the magnitude of the net force, in the same direction as the net force, and inversely proportional to the mass m of the object: $F = ma$." That means, an external force F acted on an object will accelerate that object in the direction of F with acceleration $a = F/m$.

Newton's original statement of the Second Law was that the resultant external force F is equal to the time rate of change of momentum (mv, mass times velocity):
$F = d/dt\,(mv)$
If the mass is constant, this relationship becomes the familiar form of Newton's Second Law:
$F = m\,(dv/dt) = ma$

In early 2013 I was wondering why a small mass will gain larger kinetic energy than a big mass when both of them are affected by the same force for the same time. I mathematically noticed that when using Newton's second law and kinetic energy law to calculate the kinetic energy gained by bodies as a result of force applied on them for the same time period this pattern: "The kinetic energy an object gains as a result of force applied on it for a specific time will get halved as mass of that object doubles."
Because of that, it came to my mind these questions:
-Why is the gained kinetic energy of any object inversely proportional to its mass?
-Why can't we exert the same work on any object when we use the same force for the same time?
These two questions created some doubts to me about the current understanding of inertia so I started to analyze, theoretically, the motion of normally shaped objects on horizontal frictionless surfaces or planes and found out that inertia is misunderstood.

In this theoretical study I will give a new, clearer definition of inertia and introduce a new physical property of forces which is "force relative speed" and show why it must be considered. I will also introduce my two laws in dynamics that will better describe the motion of objects.
I will achieve these goals through theoretical studying some situations in which Newton's first and second laws have limitations that are caused by inertia. For simplicity, I will only analyze the motion of the spherical inelastic object on a perfectly horizontal frictionless surface in a vacuumed isolated system.

ANALYSIS AND DISCUSSION

Cases

Here are some situations in which inertia conflicts with Newton's first and second laws and a discussion of the reasons behind that.

Case 1: The object is stationary and not affected by any external force

Assume we have a spherical inelastic object at rest on a perfectly horizontal frictionless surface in a vacuumed system. The forces affecting the object are shown in Figure 1 and these are: The Gravitational Force perpendicular to the surface "F_G"[1], Gravitational Forces from Left "F_{GL}", Gravitational Forces from Right "F_{GR}", and Normal Force "N".

The vertical components of F_{GL} and F_{GR}, which are "F_{VGL}" and "F_{VGR}" respectively, together with F_G contribute to weight of the object. The horizontal components of F_{GL} and F_{GR}, which are F_{HGL} and F_{HGR} respectively, have the same magnitude and opposite directions thus, they cancel each other. Likewise, the object weight and normal force "N" cancel each other because they have the same magnitude and opposite directions. Thus, the object in Figure 1 is at rest because it is affected by a zero net force hence, this case is not violating or conflicting with Newton's laws.

1) I expressed the symbol "F_G", for instance, in italic to mean that it is newly created and to distinguish it from the conventional and already used physics symbols, and this applies on the rest of the new symbols all over this study.

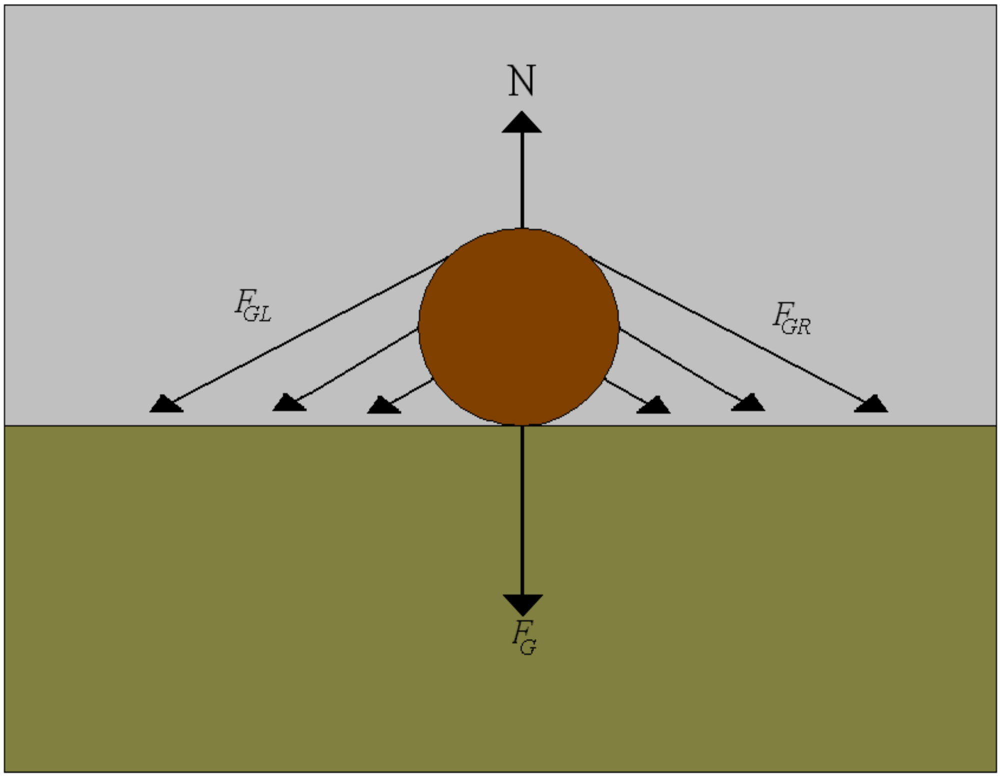

Figure 1. The Forces on the stationary spherical inelastic object which is placed on a horizontal frictionless surface in a vacuumed system.

Case 2: The stationary object is acted on by a small external force

According to Newton, any unbalanced external force regardless of its magnitude is supposed to change the motion state of the affected object. That means, the object in Figure 1 must move when it is acted on by an external unbalanced force no matter how *small* that force is.

Assume that a *very small* external force "F1" is acted horizontally on the object and is directed to right as shown in Figure 2. The object was stationary before being affected by the small external force "F1" because it was balanced by F_{HGL}, F_{HGR}, F_{VGL}, F_{VGR}, F_G and N. Therefore, according to Newton's first law the object is supposed to move to right due to being acted on by the unbalanced F1.

On the contrary, the object will not move at all even though it is acted upon by the unbalanced external force "F1".

To clarify why we will get this unexpected result I have to introduce the new physical concept "Force Relative Speed" and my first law in dynamics.

Force Relative Speed

Force Relative Speed, denoted as *FRS*, is a very important physical property of all forces including the static forces and is defined as:

"***Force Relative Speed (FRS) is the speed of the matter, which represents the force, with respect to the object or matter affected by that force."***

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Postulates of the property

I postulate in the property of force relative speed the followings:

1-Every force whether it was visible or not, static or not, should be represented by matter. In other words, any force has to be materialized in order to be existed.

2-The process of exerting any type of force on any object is done through a collision or contact between matter representing that force and matter representing that object.

Every force must be represented by a particle, object or any type of matter. The normal force on the object of this study is materialized (or represented) by the surface or plane upon which the object is placed. According to the property of force relative speed (*FRS*) the gravitational forces: F_{GL} and F_{GR}, consequently their horizontal and vertical components, are materialized and have their specific force relative speeds with respect to the object even though those forces are static and the object is inside a vacuum. As long as there are gravitational forces on any object inside any closed isolated system then there should be a matter materializing or representing them.

The gravitational forces F_{GL} and F_{GR} are represented by matter (or units of matter) that are pushing or pulling [2] the object toward left and right, respectively. Also, any external force acted on the object must be materialized and must have a specific relative speed (*FRS*) in order to be acted on that object despite it is in a vacuum. Generally, whenever there is a force on any object there must be a collision or contact between matter representing that force and matter representing that object.

For simplicity, I will term the force which has the greatest relative speed (*FRS*) as the "fastest force" and the force with high relative speed (*FRS*) compared to other forces as "fast force". Likewise, for simplicity, I will term the force with low relative speed (*FRS*) as "slow force".

2) In this study it is not necessary to specify whether F_{HGL}, for instance, are represented by matter that push the object from its right side toward left or represented by matter that pull the object from its left side toward left since we are only concerned about the force relative speed (*FRS*) of F_{HGL} not their place of action and this applies on the rest of forces (i.e. the exact place of action of any force on any object is not of concern all over this study).

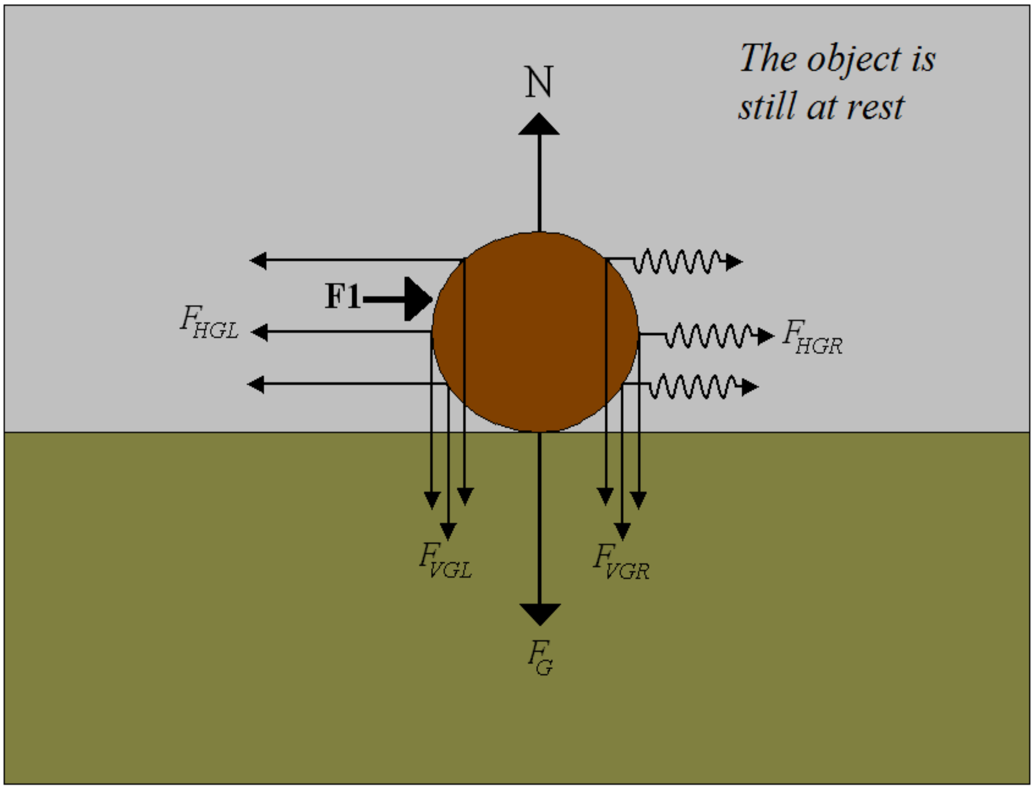

Figure 2. The spherical inelastic object, which is placed on the same surface and in the same system as that of Figure 1, is still stationary despite being affected by the external force "F1".

First Law of Dynamics

The current way of adding forces, which have the same direction, to each other in order to obtain their equivalent force is wrong because it does not take into account the differences in force relative speed (*FRS*) among them. Therefore, I will introduce my first law in dynamics which states:

"The magnitude of the equivalent force of two or more forces, which have the same direction but differ in their relative speeds (FRSs), is a value between magnitude of their fastest force and the sum of magnitudes of all those forces. As the variation in the relative speed (FRS) of those forces increases, the magnitude of their equivalent force will get closer to the magnitude of their fastest force."

That means, if the object of this study, for instance, is acted on by a group of forces which have the same direction but different *FRSs*, then their fastest force will exert all of its magnitude while each of the rest of those forces will exert part of its magnitude on the object depending on how slower it is than the fastest force.

More specifically, the slowest force will exert the lowest ratio (or percentage) of its magnitude on the object within the shared time of contact of those forces with the object, while the second fastest force will exert the highest ratio (or percentage) of its magnitude within that shared time of contact with the object and the fastest force will exert 100% of its magnitude with that time of contact. The shared time of contact of all the forces with the object is the time of contact of the fastest force with the object. After the fastest force has done all of its magnitude, the slower forces can exert what have left of magnitudes on the object. *In other words, there is no way to add the whole magnitude of a slow force (low FRS) to the whole magnitude of a fast force (high FRS) on any object within their shared time of contact with that object which equals the time of contact of the fast force with that object. Also, if the difference in FRS of those two forces increases the magnitude (or action) of the slow force on the object within the shared contact time will decrease.* As a result, the equivalent force of a fast force & a slow force has a magnitude between the magnitude of the fast force and sum magnitudes of those two forces. Of course, the equivalent force has the same direction as its components; the fast & slow forces. Note, the first law doesn't concern with the forces on the object that are perpendicular to the external force since the effect (or magnitude) of those forces will not be changed during action of that external force no matter how faster it is than those forces.

Conditions of the law

The first law will be most apparent or noticed if the forces in the same direction and the object, affected by those forces, are existed in a totally empty system that is free from any type of matter and this is the ideal environment to calculate the equivalent force. However, the system in which the object of this article is placed best mimics the ideal environment since there is no friction or air that may resist motion and the surface is perfectly horizontal, but still there is some matter inside the vacuum, at least the matter responsible for the gravitational forces is still existed, otherwise there will be no gravity inside that system as I implied in the property of force relative speed (*FRS*). In all cases, whether the object is placed in the ideal environment, in the system of this study, or in air these conditions must be met for the first law to be most applicable and apparent.

1- The object and the forces on it must be represented by inelastic matter. Elasticity will mask the effect of force relative speed (*FRS*) to a considerable extent during the collision or contact of matter representing the forces and matter representing the object.

2- All the forces of concern (the external force and the forces on the object in the same direction and parallel to it) must touch or contact the object at the same moment or time.

Back to case 2

After introducing the new physical property "Force Relative Speed (*FRS*)" and my first law in dynamics which shows how force relative speed (*FRS*) affects the equivalent force of forces having the same direction but have different *FRSs* , I can explain why the small unbalanced external force "F1" will not be able to move the object in case 2. Keep in mind that the matter representing F1 is very faster than the matter representing F_{HGR}, or F1 has much greater force relative speed (*FRS*) than F_{HGR}. All of the external forces of concern all over this theoretical study either have greater *FRS* than the forces on the object in the same direction or don't have the lowest *FRS* among those forces.

Currently, it is thought that the equivalent force of F1 and F_{HGR} is simply their sum (F1 + F_{HGR}) since they have the same direction and affect the same object at the same time. In this case, F1 is supposed to be able to move the stationary object in Figure 2 no matter how small it is because the equivalent force of F1 and F_{HGR} will equal their sum (F1 + F_{HGR}) which is larger than F_{HGL}. But when we add F1 and F_{HGR} in that way to obtain their equivalent force we ignore the variation in force relative speed (*FRS*) among them.

According to my first law, there is no way that F_{HGR} and F1 can exert all their magnitudes (or actions) on the object within the same time period of contacting that object even though they touch it at the same moment and have the same direction, that's because they differ in force relative speed (*FRS*). More specifically, the magnitude of the equivalent force of F1 and F_{HGR} is greater than that of F1 and smaller than sum of their magnitudes (F1 + F_{HGR}). That means, F1 will exert all of its magnitude (or action) on the object while F_{HGR} will exert only part of its magnitude during the action of F1, therefore I denoted F_{HGR} as wavy arrows in Figure 2 to mean that part of their magnitudes will be spared (or lost) during the action of F1. Moreover, according to my first law the equivalent force of F1& F_{HGR} is very close to F1 rather than to their sum (F1 + F_{HGR}) since F1 is very faster than F_{HGR}. The equivalent force of F1& F_{HGR} will get closer to F1 as F1 gets faster than F_{HGR}. In other words, the magnitude of F_{HGR} that will be exerted on the object during the action of F1 will get smaller as F_{HGR} gets slower than F1. Since F1 has a very small magnitude the equivalent force of F1 and F_{HGR}, which is greater than F1 but close to it, will not be able to overcome F_{HGL} which still have the same magnitudes as before F1 took place [3].

In general, when a small external force is acted on the object, which is placed in a system or environment where it is affected by opposed forces [4], there will be a net static force, denoted as $F_{NS(I)}$, on it that will oppose the external force and corresponds to the difference between sum of forces on the object opposite to that external force, which still have the same magnitudes as before that external force took place and as long as the object stays at rest [3], and sum of the new magnitudes of the forces in the same direction as that external force, which now have lower magnitudes than they used to have before applying the external force, in accordance with my first law. I mean by "small force" the force that can't change the motion state of the object since it will not be able to overcome $F_{NS(I)}$. Therefore, contrary to Newton, the stationary object in case 2 will not move at all despite it is affected by an unbalanced external force. Generally, the net static force "$F_{NS(I)}$" is mathematically given by Equation 1:

$$F_{NS(I)} = F_{net\ op(0)} - (F_{net\ same(0)} - X_F) \qquad (Eq.\ 1)$$

Where:

$F_{net\ same(0)}$: The net force of the forces on the object in the same direction as the external force "F" with the magnitudes those forces used to have before applying F on the object (i.e. the net force of $F_{same(0)}$, hence I used the nought notation).

$F_{net\ op(0)}$: The net force of the forces on the object opposite to the external force "F" with the magnitudes those forces used to have before acting F on the object (i.e. the equivalent or net force of $F_{op(0)}$, hence the nought notation is used in the symbol).

X_F : Loss in magnitude of $F_{net\ same(0)}$ while acting the external force "F" (or the total loss in magnitudes of the components of $F_{net\ same(0)}$ ($F_{same(0)}$) during applying F on the object). As F gets faster than the components of $F_{net\ same(0)}$, the factor X_F will get greater.

By substituting the values of case 2 in Eq. 1 we will get the magnitude of the net static force ($F_{NS(I)}$) that will oppose F1 as shown in Equation 2:

$$F_{NS(I)} = F_{net\ HGL(0)} - (F_{net\ HGR(0)} - X_{F1}) \qquad (Eq.\ 2)$$

Where:

$F_{net\ HGL(0)}$: The net force of the horizontal components of the gravitational forces on the object from left (F_{HGL}) with the magnitudes that F_{HGL} used to have before applying F1 (i.e. the net of $F_{HGL(0)}$).

$F_{net\ HGR(0)}$: The net force of the horizontal components of the gravitational forces on the object from right (F_{HGR}) with the magnitudes that F_{HGR} used to have before applying F1 (i.e. the net of $F_{HGR(0)}$).

X_{F1}: The loss in magnitude of the equivalent of $F_{HGR(0)}$ ($F_{net\ HGR(0)}$) during the action of F1 on the object. Or the total loss in the magnitudes of $F_{HGR(0)}$ while acting the external force "F1" on the object.

$F_{HGL(0)}$: The horizontal components of the gravitational forces from left with the magnitudes those forces used to have before applying F1, hence the note notation is used in the symbol.

$F_{HGR(0)}$: The horizontal components of the gravitational forces from right with the magnitudes those forces used to have before applying F1, hence I used the note notation in the symbol.

3) As long as the external force doesn't move the object, the forces on the object opposite to that external force will maintain the magnitudes that they used to have before acting that external force. Otherwise, if the object moves those forces will have greater magnitudes as I will show in case 3.

4) The opposed forces of concern all over this study are those opposed forces on the object which are parallel to the external force or/and to the direction of movement, not the opposed forces that are perpendicular to the external force or/and to the movement direction.

The factor "X_{F1}" in Eq. 2 represents the loss in magnitudes of F_{HGR} while acting F1 on the object due to F_{HGR} have lower *FRS* (or slower) than F1. As the force relative speed (*FRS*) of F1 becomes higher than that of F_{HGR}, the factor X_{F1} will increase resulting in greater $F_{NS(I)}$. Note that F_{HGL} still have the same magnitudes as before F1 took place, and that's due to the object will not be moved by F1 since it is very small.

In summary, case 2 violates Newton's first and second laws because small external unbalanced forces *will not* be able to move or accelerate the stationary object despite being placed on a horizontal frictionless surface in a vacuumed system thus, affected by a zero net force before being acted on by those small external forces.

Case 3: The object is moving and not affected by external forces

In this case I will analyze the motion of the spherical inelastic object when it is not affected by any external force and moving in a straight line on the horizontal frictionless surface in the vacuumed system.

Suppose a considerable force "F2", which is directed to right, was acted on the stationary object of Figure 1 for some time and then removed. The object, as a result of "F2", was accelerated to speed "v_1" to right as shown in Figure 3. According to Newton, the object is supposed to maintain v_1 to right forever as long as it is in the vacuumed system on the horizontal frictionless surface since there is no friction or air that may resist its movement.

On the contrary, that will not happen and the object's initial speed "v_1" will start to decrease gradually once the force "F2" is removed until it reaches zero after some time (i.e. the object stops moving).

To explain this unexpected result I have to introduce my second law of dynamics.

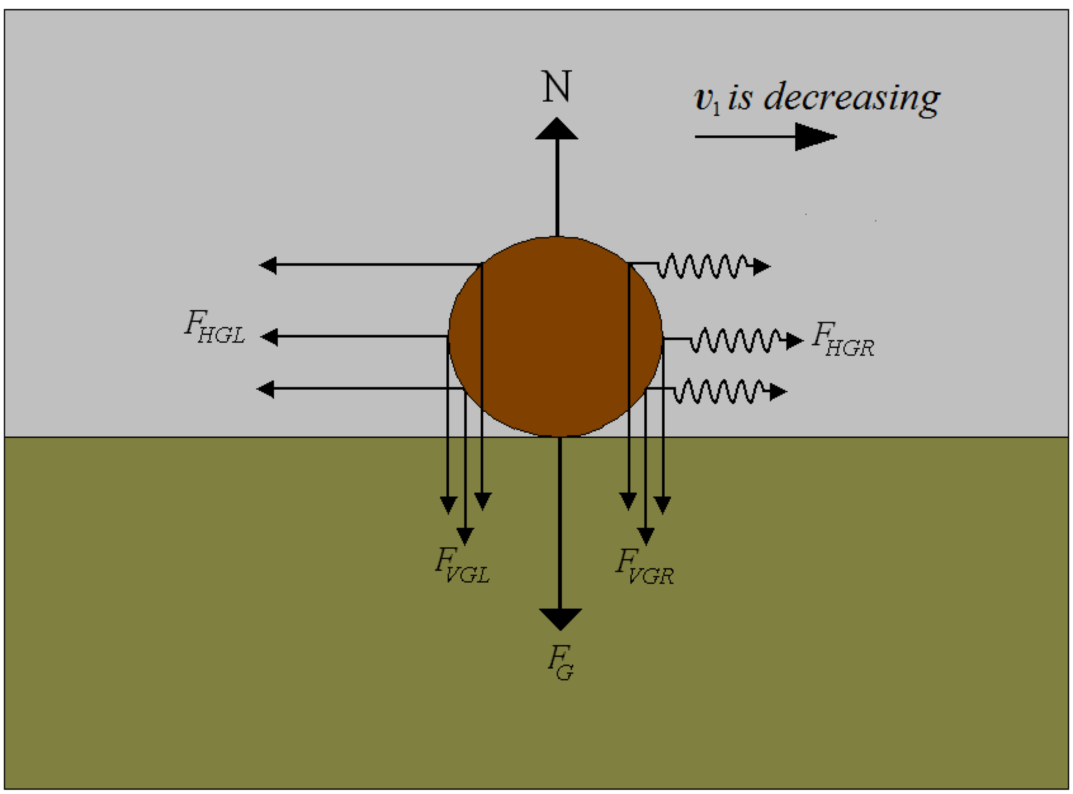

Figure 3. The spherical inelastic object, which is in the vacuumed system on the horizontal frictionless surface, is moving to right with initial speed "v_1".

Second Law of Dynamics

My second law in dynamics is about the effect of varying the force relative speed (*FRS*) of forces on their magnitudes and states:

"The magnitude of any force is directly proportional to its relative speed (FRS). If any force has zero relative speed (zero FRS) then it will have no magnitude."

That means any force, even if it is static, will have a greater magnitude if it affects the object which moves opposite to or toward it than affecting that object when it is stationary. That's due to an increase in its *FRS*. Likewise, the force will have a greater magnitude on the stationary object if it moves toward that stationary object than standing still due to the matter which represent that force will have greater speed with respect to the object, in other words, that force will have greater *FRS*. If the force relative speed (*FRS*) of any force is zero due to the matter which represents that force is not moving (or is not supposed to move after eliminating any hindrance on its path, or if the matter representing that force is already in contact with the object and not supposed to move toward it) toward (or with respect to) the object, then the magnitude of that force will be zero with respect to that object due to zero *FRS*.

Therefore, it is completely wrong to think that forces have the same magnitudes regardless of their motion or speed with respect to the affected object.

Back to case 3

Before the considerable force "F2" was acted on the stationary object, F_{HGL} was equal to F_{HGR}. But when the object gained a speed (v_1) to right as a result of F2, F_{HGL} became greater than F_{HGR}, in accordance with my second law. As long as the object is moving to right, F_{HGL} will have greater magnitudes than they used to have when the object was stationary due to increase in their *FRS*, and F_{HGR} will have lower magnitudes than they used to have when the object was stationary due to reduction in their *FRS*. Consequently, the object is not affected by a zero net force while movement as you might think, it is rather affected by a net static force that will keep opposing its movement to right until that object completely stops, contrary to Newton's laws. In general, that net static force, denoted as $F_{NS(II)}$, is given by Equation 3:

$$F_{NS(II)} = (F_{net\ op(0)} + Y_v) - (F_{net\ same(0)} - X_v) \qquad \text{(Eq. 3)}$$

Where:

v : The object's speed.

$F_{net\ op(0)}$: The net force of the forces on the object opposite to its movement with the magnitudes that those forces used to have when the object was stationary (i.e. the net force of $F_{op(0)}$ hence, the nought notation is used in the symbol).

Y_v : The increase in magnitude of $F_{net\ op(0)}$ due to increase in the force relative speed (*FRS*) of its components as a result of the object's movement at v. Or the total increase in the magnitudes of the components of $F_{net\ op(0)}$ ($F_{op(0)}$) as a result of the object's movement at v.

$F_{net\ same(0)}$: The net force of the forces on the object in the same direction as movement with the magnitudes that those forces used to have when the object was stationary, hence I used the note notation in the symbol (i.e. the net force of $F_{same(0)}$).

X_v : The decrease in magnitude of $F_{net\ same(0)}$ due to decrease in the force relative speed (*FRS*) of its comonents as a result of the object's movement at v. Or the total loss in the magnitudes of the components of $F_{net\ same(0)}$ ($F_{same(0)}$) as a result of the object's movement at v.

In case 3, the magnitude of $F_{NS(II)}$ that will oppose the object's movement to right, immediately after removing F2, is shown in Equation 4:

$F_{NS(II)} = (F_{net\ HGL(0)} + Y_{v1}) - (F_{net\ HGR(0)} - X_{v1})$ *(Eq. 4)*

Where:

Y_{v1}: The increase in magnitude of $F_{net\ HGL(0)}$ due to increase in the relative speed (*FRS*) of its components ($F_{HGL(0)}$) while the object was moving at v_1 (or the total increase in magnitudes of $F_{HGL(0)}$ as a result of the object's movement at v_1).

X_{v1}: The decrease in magnitude of $F_{net\ HGR(0)}$ due to decrease in the relative speed (*FRS*) of its components ($F_{HGR(0)}$) while the object was moving at v_1 (or the total decrease in magnitudes of $F_{HGR(0)}$ as a result of the object's movement at v_1).

$F_{net\ HGL(0)}$: The net force of the horizontal components of the gravitational forces on the object from left (F_{HGL}) with the magnitudes that F_{HGL} used to have before movement at v_1 (i.e. the net of $F_{HGL(0)}$).

$F_{net\ HGR(0)}$: The net force of the horizontal components of the gravitational forces on the object from right (F_{HGR}) with the magnitudes that F_{HGR} used to have before movement at v_1 (i.e. the net of $F_{HGR(0)}$).

The factor "Y_{v1}" in Eq. 4 represents the increase in magnitudes of F_{HGL} due to increase in their force relative speed (*FRS*) when the object is moving to right at v_1. The factor "X_{v1}" in Eq. 4 represents the decrease in magnitudes of F_{HGR} due to reduction in their force relative speed (*FRS*) as long as the object is moving to right at v_1 therefore, I denoted F_{HGR} as wavy arrows in Figure 3 to mean that they have lower magnitudes than the magnitudes they used to have when the object was stationary (i.e. lower magnitudes than $F_{HGR(0)}$).

$F_{NS(II)}$ will oppose the object's movement to right resulting in the gradual reduction in its speed until the object completely stops. As the object's speed to right decreases, $F_{NS(II)}$ will gradually decrease due to gradual reduction in factors X_v & Y_v, which are the decrease and increase in $F_{net\ HGR(0)}$ and $F_{net\ HGL(0)}$, respectively. That means, as a result of the gradual reduction in the object's speed, the extra value of F_{HGL} will gradually decrease until F_{HGL} reaches the value that used to have when the object was stationary ($F_{HGL(0)}$). Also, the loss or reduction in F_{HGR} will gradually get lower, due to gradual reduction of v_1, until it reaches zero (i.e. F_{HGR} will gradually increase until it reaches the value that used to have when the object was stationary ($F_{HGR(0)}$)).

$F_{NS(II)}$ works to decrease the object's speed. As the object's speed decreases the magnitude of $F_{NS(II)}$ will decrease and so on. That's why, the relationship between the net static force "$F_{NS(II)}$" and the object's speed is like a negative feedback loop. That means, $F_{NS(II)}$ will reduce the object's speed and in turn the new lower speed will result in a new lower $F_{NS(II)}$ and so on. *Consequently, the object's speed will gradually decrease at a gradually decreasing rate.*
The decrease in magnitudes of the forces in the same direction as movement and the increase in magnitudes of the forces opposite to movement are due to decrease and increase in *FRS* of those forces, respectively. The gap or difference between the magnitudes of opposed forces is proportional to the object's speed. That means, if the object moves at a greater speed in that system or environment then the difference in magnitudes between the opposed forces, which is the net static force "$F_{NS(II)}$", will get larger on that object and opposite to its movement and directly proportional to its speed.

Therefore, as long as the object moves an external force that is equal to $F_{NS(II)}$, given by Eq. 3, and opposite to it should be acted on the object continuously to maintain a constant speed (i.e. uniform motion), contrary to Newton. Otherwise, the object will stop after some time as a result of $F_{NS(II)}$ which will gradually decrease due to gradual reduction in the object's speed.

The magnitude of that external force depends on the speed that we want to maintain since $F_{NS(II)}$ is proportional to the object's speed. Once an external force is used to oppose $F_{NS(II)}$ the object will maintain a constant speed and $F_{NS(II)}$ will stay constant.

In summary, the motion of the spherical inelastic object in this case violates Newton's first & second laws because it is impossible to maintain a uniform motion without the continuous support of an external force despite the object is placed on a horizontal frictionless surface (plane) in a vacuumed system. In other words, the object will not maintain a constant speed in a straight line without the help of an external unbalanced force that should be acted on it continuously which exactly equals "$F_{NS(II)}$" and opposite to it, otherwise, the object will stop after some time. Contrary to Newton's first law, there is no tendency for the moving object in a straight line to keep moving, there is rather a tendency of the moving object to stop due to the net static force that will result upon the object's movement and has the opposite direction. Also, contrary to Newton's second law that external unbalanced force will not accelerate the object, it will only keep the object moving at a constant speed (i.e. moving uniformly).

Case 4: The object moves due to acting a considerable force on it

Suppose an external force "F3" which has a considerable magnitude is being acted on the stationary object of Figure 1 and is directed to right as shown in Figure 4. The object will be accelerated to "v_2" to right as a result of F3. According to Newtonian dynamics, the net force on the object is F3 all over the time of F3-object contact since the object is affected by a zero net force and balanced before and as long as applying F3 on it. *On the contrary, the net force on the object while acting F3 on it is lower than F3.*

Generally, the object will not be affected by a net force that is equal to the applied force on it despite being placed on a horizontal frictionless surface in a vacuumed system because of these two factors:

Factor One

According to my first law in dynamics, the external force will cause a reduction in magnitudes of the forces in the same direction since that external force has a greater force relative speed (*FRS*) than those forces while the forces opposite to it will maintain constant magnitudes as long as the object isn't moved by that external force.

Factor Two

According to my second law, if that external force is able to move or accelerate the object then the forces on that object in the same direction as its movement will lose part of their magnitudes due to reduction in their relative speed (*FRS*), that happened as a result of the object movement in the same direction, and the forces on the object opposite to its movement will gain extra magnitudes due to increase in their relative speed (*FRS*) that occurred due to the object's movement in the opposite direction to those forces.

Due to those two factors the considerable external force will create a net static force on the object, denoted as $F_{NS(III)}$, and opposite to it. *Therefore, contrary to Newton, when an external force is acted on the balanced object the net force on it is always lower than that external force.*
The increase in magnitudes of forces opposite to the external force is caused by one factor, which is the object's movement that resulted from acting the external force on it. But the reduction in magnitudes of the forces in the same direction as the external force is caused by two factors which are; the external force and movement. I can't say that the loss in magnitudes of the forces in the same direction as that external force is the mathematical sum of the two losses that are caused by the two factors; the external force and movement, and that's because there could be a synchronization or interaction between those two factors, that's why we need to make very accurate and precise experiments to quantify the effects of those two factors together and individually. Mathematically, $F_{NS(III)}$ is given by Equation 5:

$$F_{NS(III)} = (F_{net\ op(0)} + Y_v) - (F_{net\ same(0)} - Z_{v,F}) \qquad \text{(Eq. 5)}$$

Where:

$F_{net\ op(0)}$: The net force of the forces on the object opposite to its movement with the magnitudes that those forces used to have when the object was stationary (i.e. the net of $F_{op(0)}$).

Y_v: The increase in magnitude of $F_{net\ op(0)}$ due to increase in the relative speed (*FRS*) of $F_{op(0)}$ as a result of the object's movement in the opposite direction to $F_{op(0)}$ at v.

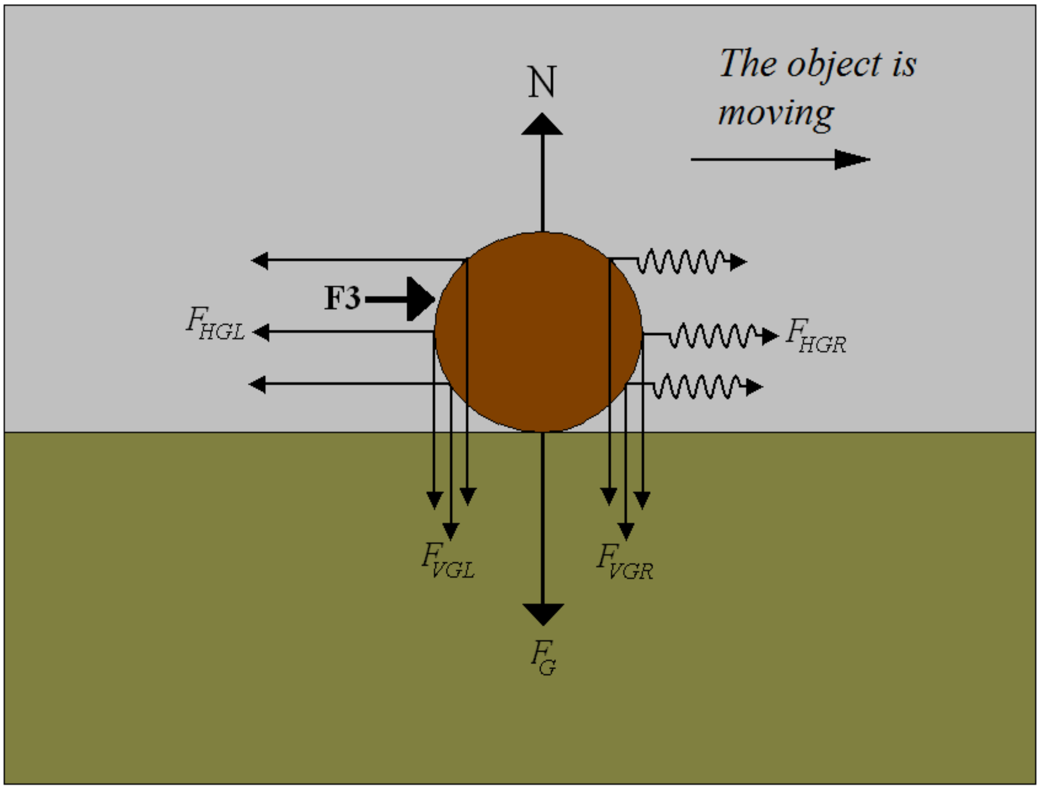

Figure 4: The spherical inelastic object, which is in the vacuumed system on the horizontal frictionless surface, is acted on by F3 and moving in the same direction.

$F_{net\ same(0)}$: The net force of the forces on the object in the same direction as movement (consequently, have the same direction as the external force) with the magnitudes that those forces used to have before both: acting the external force "F" and the object's movement at v as a result of that force (i.e the net of $F_{same(0)}$).

$Z_{v,F}$: The loss in magnitude of $F_{net\ same(0)}$ as a result of both: applying the external force "F" and the object's movement at v.

In case 4, exactly at the moment the external force "F3" accelerated the object to v_2, it has caused a reduction or loss in magnitudes of F_{HGR}. That reduction equals the value of $Z_{v2,F3}$ and happened as a result of both: F3 has greater relative speed (*FRS*) than $F_{HGR(0)}$ and the object is moving at v_2 to right. Therefore, I expressed F_{HGR} as wavy arrows in Figure 4, to mean that F_{HGR} now have lower magnitudes than the magnitudes they used to have before acting F3 on the object ($F_{HGR(0)}$), at least before the object reached v_2. Also as a result of the object's movement, F_{HGL} will gain extra magnitudes due to increase in their relative speed (*FRS*). Mathematically, the net static force on the object while acting F3 on it and exactly at v_2 ($F_{NS(III)}$) is given by Equation 6:

$$F_{NS(III)} = (F_{net\ HGL(0)}+Y_{v2}) - (F_{net\ HGR(0)}-Z_{v2,F3}) \qquad (Eq.\ 6)$$

Where:

Y_{v2}: The increase in magnitude of $F_{net\ HGL(0)}$ due to an increase in the relative speed (*FRS*) of its components ($F_{HGL(0)}$) as a result of the object's movement to right at v_2.

$Z_{v2,F3}$: The loss in magnitude of $F_{net\ HGR(0)}$ due to decrease in the relative speed (*FRS*) of its components ($F_{HGR(0)}$) as a result of both: applying F3 and the object's movement to right at v_2.

What Is Inertia?

Recall that in case 2 the object will not move when affected by the small external force "F1" despite it is at rest and placed on a perfectly smooth horizontal surface in a vacuumed system thus, affected by a zero net force, and that's due to the net static force "$F_{NS(I)}$" on the object opposite to F1 and will evolve once F1 contacts the object.

In case 3, the object will stop despite moving on the horizontal frictionless surface in a vacuumed system and that's due to the net static force "$F_{NS(II)}$" on it, which evolved once the object started moving, opposite to its movement and will keep opposing the movement. In case 4, the net force on the object is not equal to the applied force on it (F3), even though the object is placed on a horizontal frictionless surface in a vacuumed system, and that's due to the evolution of the net static force "$F_{NS(III)}$" on the object opposite to F3 and to the object's movement. $F_{NS(III)}$ evolved once the considerable external force "F3", together, contacted and moved the object.

The net static force on the object in all the cases is its inertia. Therefore, I have to introduce a new definition of inertia which states:

"*Inertia is the net static force on the object that corresponds to the difference between the original net force of the environmental opposed forces on that object and the instantaneous net force of those forces, and it makes the object resist any deviation from its original environmental acceleration or/and makes it reacquire that acceleration.*"

The environmental opposed forces are those opposed forces on the object that exist originally in the environment or system which contains the object, not the opposed forces that are external with respect to that environment or system. In this study, the environmental opposed forces are: The Gravitational Force perpendicular to the plane (F_G), F_{VGR} and F_{VGL} all together with the Normal Force (N), and F_{HGR} with F_{HGL}.

The original net force of the environmental opposed forces, denoted as "$F_{net\ env(0)}$", is the net force of the

environmental opposed forces when the object is not acted on by any external force and/or the effect of the external force, which was acted on it, has completely gone. In that case, the object is at its original or natural motion state and its acceleration is consistent with its $F_{net\ env(0)}$ and is called "original environmental acceleration", denoted as "$a_{env(0)}$".

In this study, $F_{net\ env(0)}$ is zero regardless of the object's mass since the environmental opposed forces have the same magnitude and balance each other when the object isn't acted on by external forces and/or the effect of an external force which was acted on it has gone. Since $F_{net\ env(0)}$ in the system here is zero the object $a_{env(0)}$ is also zero. Therefore, the original motion state of any object in the system of this study is to be at rest.

Generally, in any system, the environmental forces on the object in the same direction as movement, which is caused by an external force, or/and in the same direction as the external force are considered as F_{same} and if those forces still have the magnitudes that used to have when the object is at its original or natural motion state then they are considered and referred to as $F_{same(0)}$ hence, the nought notation. In this study, F_{same} are F_{HGR} and $F_{same(0)}$ are $F_{HGR(0)}$. Likewise, F_{op} refers to the environmental forces on the object opposite to the external force or/and to the object's movement that is caused by the external force (i.e. the movement at a speed greater than that when the object is at its original motion state). And if the object is at its original state of motion then F_{op} are considered as $F_{op(0)}$. Here in the study, F_{op} are F_{HGL} and $F_{op(0)}$ are $F_{HGL(0)}$.

The instantaneous net force of the environmental opposed forces, denoted as $F_{net\ env}$, is the net force of those forces at any moment or instant. $F_{net\ env}$ equals $F_{net\ env(0)}$ when the object is at its original (or natural) motion state, consequently, at that situation the object has its original environmental acceleration ($a_{env(0)}$). In other words, there should be no difference between $F_{net\ env}$ and $F_{net\ env(0)}$ when the object is not affected by any external force or/and there is no effect of a removed considerable external force that was acted on it. The effect of the considerable external force on the object after removing it is the deviation from that object's $a_{env(0)}$, otherwise if the external force wasn't able to change the original motion state of the object because it is very small, as in case 2, then it will not have any effect after removing it.

Inertia is the net static force on the object that will create a tendency of that object to stay affected by its original net force of the environmental opposed forces on it ($F_{net\ env(0)}$) or/and to reacquire the state of motion in which the object is only affected by its $F_{net\ env(0)}$. Consequently, inertia will make the object resist any deviation or increment from its original environmental acceleration ($a_{env(0)}$) or/and will make it reacquire its original environmental acceleration ($a_{env(0)}$). That's why, inertia is always opposite to any external unbalanced force applied on the object and/or to its effect, which is the deviation from the object's $F_{net\ env(0)}$ & $a_{env(0)}$. That also means, inertia will evolve once the instantaneous net force of the environmental opposed forces on the object ($F_{net\ env}$) starts to deviate from $F_{net\ env(0)}$ and the difference represents the object's inertia which is a static force on that object. Keep in mind that the deviation from $F_{net\ env(0)}$ may happen as a result of applying an external unbalanced force and/or the object has a different acceleration from its $a_{env(0)}$ (i.e. when the object is not in its original motion state).

In case 2, the object had a different $F_{net\ env}$ from its $F_{net\ env(0)}$ as long as the external force "F1" was acted on it, that's why the object had inertia and was represented by $F_{NS(I)}$ which opposed F1 and prevented it from changing the object's original motion state, which is standing still. In other words, inertia evolved once F1 contacted the object and was able to overcome and cancel the effect of F1 because it is very small, thus the object stayed at rest.

In case 3, the object is affected by a different $F_{net\ env}$ from its $F_{net\ env(0)}$ just after removing the considerable external force "F2" and as long as it is moving to right as a result of F2, consequently the object has a different acceleration from its $a_{env(0)}$. Therefore, inertia evolved and caused the object to slow down until the object stopped. Inertia in case 3 is the difference between the object's $F_{net\ env}$ and its $F_{net\ env(0)}$ and that difference (inertia) is caused by only the movement since we started to analyze the object's motion once the considerable external force "F2" was removed. Inertia in case 3 was represented by $F_{NS(II)}$ which kept opposing the object's movement until the object stopped.

In case 4, the object is affected by $F_{net\ env}$ that is different from its $F_{net\ env(0)}$ as long as the considerable external force "F3" is acted on it, therefore the object has inertia which opposes both of the external force "F3" and movement together. Inertia evolved in case 4 and it is represented by the net static force "$F_{NS(III)}$". Since inertia ($F_{NS(III)}$) opposed F3 it made the net force on the object lower than the applied force on it (F3), contrary to Newton's laws.

From cases 2, 3 and 4 you can see that inertia is the net static force on the object that creates a tendency of the object to stay at rest if it is at rest or to come to rest if it is moving due to the original motion state of the object in the system here is to be at rest.

Any object will have inertia only if it is in an environment or system where it is affected by opposed forces. According to the property of force relative speed (*FRS*), if the object was in an empty system (or environment) that is free from any type of matter then it will not have inertia since there are no forces on the object. The presence of matter contacting the object is necessary for the presence of opposed forces on it which are necessary for having inertia. Therefore, it is very important to note that if the matter representing the opposed forces on the object were not uniformly distributed in the system (or environment) which contains that object then it will have different inertia from point to point within that system or environment due to the resulting variability in the magnitudes of opposed forces on that object. In that case, we should divide that system into subsystems which have homogenous (or uniform) distribution of the matter representing the forces (or dividing that system into homogeneous fields of forces) in order to better understand the motion of the object within the whole system. When we do that we can exactly predict the position and the speed of the object regardless of its mass at any time. I implicitly mean that the reason of the conflict between classical mechanics and quantum mechanics is because of the flaws or limitations of Newtonian mechanics, which are caused by inertia. That means, if we want to predict the position and speed of any object at 100% accuracy in a system or environment where the object is affected by opposed forces (thus, it will have inertia upon acting an external force on it), then we have to follow my dynamics.

In the system of this study the object is affected by the same set of opposed forces with the same magnitudes at every point on the perfectly horizontal frictionless surface or plane. Therefore, the matters representing the opposed forces on the object are distributed homogeneously (or uniformly) at every point in the system of this study. That's why, the motion of the object in this study is very analogous to its motion within a sensible fluid of matter even though the object is inside a vacuumed system.

If the object is in a system (or environment) that is free from any type of matter, then it will not have inertia since the object in that system will not have an original motion state (i.e. there will be no $F_{net\ env(0)}$ on the object and consequently that object will not have $a_{env(0)}$) because there will be no opposed forces due to the absence of matter in that system. In that system, Newtonian dynamics can be perfectly applied and any external force of any magnitude is supposed to be able to change the motion state of the object of any mass, and the object in motion will stay in motion until an external force, of any magnitude, is acted on it.

CONCLUSIONS

The understanding of inertia has been wrong for more than 300 years since Newton introduced his first & second laws. Therefore, Newtonian dynamics is not accurate and must be reconsidered. Inertia is not the tendency of the object at rest to stay at rest or the tendency of the moving object to maintain its state of motion until an external force is acted on it. Inertia is rather a static force on the object that works to maintain or/and reacquire the original motion state of the object as long as it is in a system where it is affected by opposed forces or placed within a field or more of opposed forces.

Also contrary to Newton's physics, there is no way for any object placed in an environment, where it is balanced or affected by opposed forces of equal magnitudes, to maintain a uniform motion (constant speed) without the help of an external force.

In the absence of inertia (i.e. the object is in a perfectly empty system or universe that is free from any type of matter) Newton's first & second laws can be perfectly applicable. In that case, the object will maintain a uniform motion until an external force is acted on it.

The current thinking that the speed of moving objects on horizontal planes (or surfaces) decreases due to the effects of friction and air resistance alone is wrong, we have to take into account the effect of inertia, which is a force. According to the dynamics that I introduced in this study, the motion of the objects in horizontal frictionless paths at constant speeds (or velocities) such as the rotation of planets around the sun is also misunderstood since it is impossible for any planet to maintain a constant speed in a field, where it is affected by opposed forces, without the help of an external force, contrary to Newton. Also, the measurement of any physical parameter which is obtained by following Newtonian dynamics must be reconsidered. For example, according to my dynamics, the value of the universal gravitational constant, obtained by Henry Cavendish, is wrong and that's because Henry followed Newton's dynamics to explain his results. Consequently, any other physical measurement that is depending on the current universal gravitational constant, such as the mass of earth, is also wrong.

REFERENCES

[1] Sohn-Rethel, Alfred, and Martin Sohn-Rethel. *Intellectual and manual labour: A critique of epistemology*. London: Macmillan, 1978.
[2] Chandrasekhar, Subrahmanyan. *Newton's Principia for the common reader*. Oxford University Press, 2003.
[3] Peck, William Guy. *Elements of Mechanics: For the Use of Colleges, Academies, and High Schools*. AS Barnes & Burr, 1859.

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