The real Cause for relative motion of bodies - force or energy?

Anemut Denkalem

Dimensions Consulting Architects & Engineers

Addis Ababa, Ethiopia. tel: +251 (0) 911653178 , PBox = 489 code1250

e-mail – Dimensions@ethionet.et

Abstract: Energy is the real physical quantity for the law of inertia. In this short paper a theoretical close up and analysis is made to show that bodies will change their relative position if and only if external energy is applied on them and that Newton's 2nd law of motion has some inconsistency with the law of energy conservation when describing motion of bodies. It also aims to show that it is not only the physical quantity force alone that is responsible for the relative change in position of bodies but also the distance the force moves. Distance is a necessary physical quantity to determine the acceleration of the body. Motion is the process by which bodies try to balance the excess energy applied on them, whether the bodies are small (particles) or large (stone). The well accepted physical law, energy conservation law, is taken as the basis for the verification of this idea. When bodies move, linearly, rotationally, etc, energy is conserved. Simple graphical analysis of the physical parameters involved in the motion of bodies using examples illustrates these claims. It is, therefore, possible to say that this could lead to further reconsideration of classical mechanics when describing the concept of force-motion relationship.
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Key words: Force; energy; motion

1. Introduction

Almost everything in the universe, small or large, relatively moves. It is difficult to find an object that is absolutely stationary. Relative motion (change in position) is a very inherent characteristic of matter. Planets move, particles move , animals move etc. It is very natural and primary, therefore, to examine what really causes the motion of bodies and try to formulate laws of motion. Philosophers and scientists are on the front line in the business of describing what motion is, what its root cause is and come up with the laws of classical dynamics. Ilya Prigogine (1980) says "it is very unfortunate that most college and university text books present classical dynamics as if it is a closed subject. In fact it is a subject in rapid evolution. Classical dynamics, perhaps the most elaborated of all theoretical sciences is not a closed science. We can pose meaningful questions to which it yields no answer". The primary objective of this report is therefore to pose such questions on seemingly simple, well accepted laws of classical dynamics-Newton's law of inertia and 2nd law of motion. According to Newton's 1st law of inertia, a body which is relatively at rest will change its position if an external force acts on it. In other words force is the cause for relative motion. When a force is applied on a body, it will begin to accelerate. However what is applied on it? Force or energy?. For the founders of modern physics the only change that could be expressed in precise mathematical terms was then acceleration, the variation in the state of motion (Prigogine 1980). This finally led Newton to develop the fundamental equation of classical mechanics which relates acceleration to the applied force /Prigogine 1980/

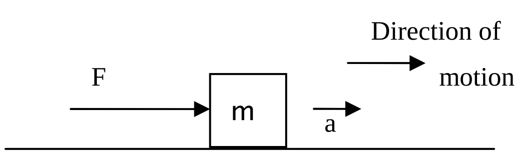
i.e : $F = ma$

A second type of description of motion is suggested in Einstein's general theory of relativity. According to this theory motion is (or can be) caused by space –time curvature. Planets (the earth for instance) is kept in orbit around the sun because it rolls along a valley in a warped spatial fabric (Greene 1999). It follows a "path of least resistance" in the distorted region around the sun (Greene, 1999).

A third opinion for the cause of motion is suggested by this report-Energy. Whether small or large a certain mass in relative rest will change position only if energy is applied on it. This is invariant to the type of motion – linear, rotational, gravitational etc. If a body is in motion, then we are sure that there must be a certain quantity of energy applied on it before it begins the motion (by energy conservation law). From the equivalence of the applied energy before motion and the energy of motion (Kinetic energy) it is possible to show the inconsistency between 2nd law of classical mechanics (F = ma) and the energy conservation law.

2. Inconsistency between Energy conservation law and Newton's 2nd law of motion (F = ma)

In colleges and universities we all learnt that acceleration of a body is related to the force applied on it by Newton's 2nd law of motion (F=ma). Acceleration is directly proportional to the force applied and inversely proportional to the mass. And graphically represented as follows:



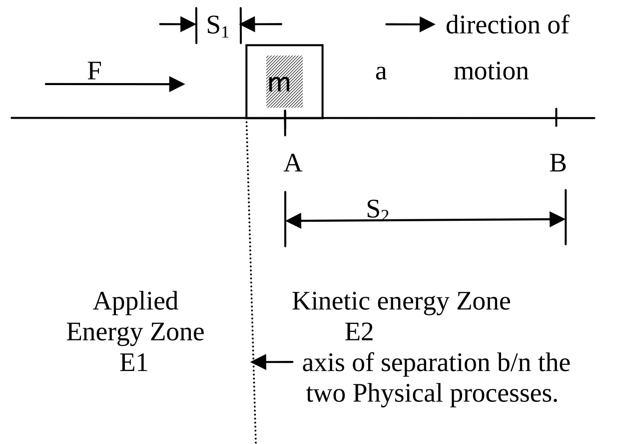
If: F = force applied

m = mass of the body

a = acceleration of the body

Then F = ma

Here, acceleration is the result of the applied force F only. But looking at the process closely, it is very difficult to imagine the application of F with out a definite distance F moves before it touches the mass. In reality F moves a definite distance, S_1 before it touches the mass (M). When F moves distance S_1, work is done and the applied physical quantity becomes Energy. Diagrammatically, the analysis is as follows:



Let: F = applied force on mass m

S_1 = distance the force F move before it touches the mass (m).

m = the mass of the body

a = the acceleration of the body after the Force F touches the mass

S_2 = total distance travelled by the mass between points A and B after the force is applied. Assuming that the surface of motion is frictionless, energy must be conserved for the whole system. i.e.:

Applied Energy = Kinetic energy

$$E_1 = E_2 = \frac{(v^2)m}{2}$$

But for the zone of the kinetic energy

$$V^2 = \not{U}^2 + 2as_2$$

$$\frac{V}{2} = aS_2$$

E2 = mas_2 ------- ------ ---- 1

The applied energy is expressed as the work done by the force F:

E1 = FS_1 - - - - - - - - - - - - - - - 2

But $E_1 = E_2$

This implies

$$\boxed{FS_1 = maS_2}$$

Better describes the system. But it is very clear that distance moved by the force F and distance moved by the mass M are not necessarily equal.

i.e. $S_1 \neq S_2$

We therefore conclude that F ≠ ma; the applied force on the mass M is not equal to the mass times the acceleration of the body as suggested by Newton's 2nd law of motion.

The relationship $FS_1 = maS_2$ suggests that the magnitude of acceleration is governed by the two physical quantities together force & distance the force moves.

From $FS_1 = maS_2$

$$a = (F/m)(S_1/S_2)$$

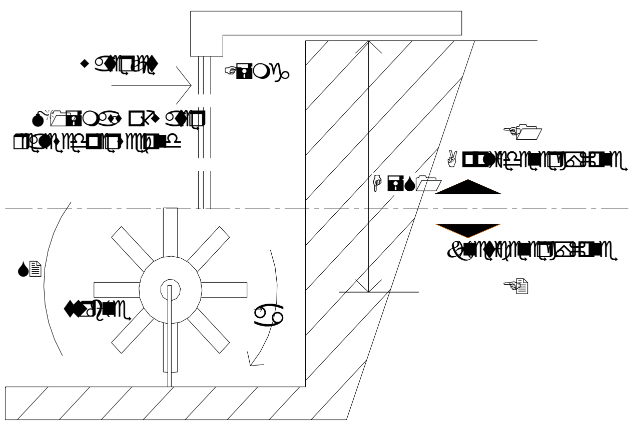
; S_1/S_2 is the remaining multiplication factor to be added in the 2nd law to be consistent with energy conservation law. If S1/S2 = k; then

$$a = kF/m \longrightarrow F = kma$$

It is only when $S_1 = S_2$; as in the case of pushing a mass from rest to its destination point ; freely sliding mass on an inclined plane; free fall etc; k = 1 and a = F/m. Note also that if S1 = 0, F can not be applied on mass m.

The inconsistency of the 2nd law can also be explained in gravitational field motion as follows:

Let's consider the motion of a simple water turbine as an example



Let jet of water is released from a height (h) to accelerate a turbine below which is at rest.

Let: m1 = the mass of water released per second; F=mg

S1 = h is the distance the weight of water moves before it touches the turbine.

a = rotational acceleration of the turbine

m2 = mass of turbine

S2= the rotational distance moved by the turbine.

Then the energy conservation for the whole system shall be:

Applied Energy (Potential energy) = rotational energy (Kinetic energy of turbine)

The potential energy can generally be given as: $E_1 = FS_1$

The kinetic energy (rotational energy) can generally be given as:

$$E2 = m_2aS_2$$

$E_1 = E_2$ By conservation law; therefore

$$FS_1 = m_2aS_2$$

We know that $S1 \neq S_2$. It implies then that $F \neq m_2a$; the applied force on a turbine of mass m2 is not equivalent to the mass of the turbine times its rotational acceleration. It is also possible to recognize that the physical quantity energy (the potential energy) is responsible for the rotational acceleration of the turbine from rest. The magnitude of the acceleration depends both on F and the distance F moves (S_1). If $S_1 = 0$ we cannot apply F = mg on the turbine. If we cannot apply F with out S_1; one cannot say that F is responsible for the motion of the turbine.

3. Conclusions

In this short analysis (using conventional examples); it has been realized that the physical quantity energy is responsible for the relative motion of bodies. And therefore, some adjustments have to be made to rectify the 2nd law of motion /F = ma/ to be consistent against the law of conservation of energy. This could have greater implications on the previous description of motion of bodies. According to this report if any physical entity in this universe moves, we are sure that there must be pre applied energy on the mass to bring it in motion. Cars move because of and equivalent to the energy applied on them; stones roll because of and equivalent to the energy applied on them; planets move around the sun and on their axis because of and equivalent to the energy applied on them etc. And motion can be described as the flow of energy from one form to the other. What is this physical quantity energy is then? No one knows what it exactly is (Richard P. Feynman 1996). What we know is its role in moving objects of the physical world. We don't know exactly from where for instance the initial energy that is responsible and equivalent to the rotational or revolutional energy of the planets comes from. The concept of energy as the initial cause for the motion of bodies and as the physical quantity for the law of inertia can, for example, be extended to explain rotation and revolution of objects like planets. We know that a rotating spin suspended in air has a tendency of revolution in elliptical path. This can be, true phenomenon for big bodies like planets. The point therefore will be to find the source of the pre applied energy which is the cause for rotational kinetic energy of planets; from where it comes?

The validity of the idea that only energy is the cause for motion of bodies, can lead to the redefinition of some of the classical dynamic norms.

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