The Experiment of Inertia and Acceleration in Classical Mechanics

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Abstract. Had a paper it about inertia The difficulting of inertial in classical mechanics , in this paper , the inertial is have nothing to do mass , it depend on acceleration and provide a formular that is look like Tylor’s formula . It instruction the inertial mass as increase as acceleration, so inertial mass is different from gravitational mass. In this paper, the auther used to a experiment and proved the inertia is depend on acceleration.

Keywords: Inertial, Accelerate, System of Refrencely, Relativity, Experiment

Introduction

The value of inertia depend on the value of acceleration, so the inertial mass as vary as the acceleration too. This kind of phonomena can be detection in experiment and that is simple. In this paper, the auther well to application this experiment and prove the theory of the value of inertia depend on the value of acceleration.

The Base of Theory in Experiment of Inertial

The inertia is a concept in mechanics that is importance, because it can metrics the degree of state of object in kinetics: kinetic or static [1]. For the object of kinetic, the inertia is to be performance for dynamic energy:

\[ E = \frac{1}{2} m_i v^2 \] (1)

For the falling motion, it performance for variable of potential energy of gravity :

\[ \frac{1}{2} m_i v^2 = m_g g h_2 - m_g g h_1 \] (2)

Obviously, the value of variable of gravity potential it equivalent to half of square of velocity if the gravitational mass equivalence to inertial mass :
In fact, the gravitational mass is different from gravitational mass, it can as variable as acceleration, so the (3) is error if the object of kinetic has acceleration that is variable. In this situation, the inertial mass and velocity are variables, so the dynamic energy is a variable too. For the central force, the (2) can to be generalization:

$$\frac{1}{2} \sum_{i=0}^{n} \frac{d^i m}{dt^i} \left( \sum_{i=0}^{n} \frac{d^i v}{dt^i} \right)^2 = m_g \sum_{i=0}^{n} \left( \frac{d^i a}{dt^i} \right) \left( \frac{d^i x}{dt^i} \right)$$

(4)

This is theorem of dynamic energy of generalized, attention, this it applicable the system of centroid, our discover, this effect is over than system of Newton’s mechanics if decomposition the vector in (4). Clearly, this kind of effect is continuous, so it still can differential to time

$$\frac{1}{2} \frac{\partial}{\partial t} \sum_{i=0}^{n+1} \frac{d^i m}{dt^i} \left( \frac{d^i v}{dt^i} \right)^2 = m_g \sum_{i=0}^{n+1} \frac{d^i a}{dt^i} \left( \frac{d^i x}{dt^i} \right)$$

(5)

if it think the direction of inertial force positive, so change the (1.5)

$$f_i = \sum_{i=0}^{n} \frac{1}{(i+1)!} \frac{d^i m}{dt^i} \left( \frac{d^i v}{dt^i} \right)^{i+1} \sum_{i=0}^{n} \frac{1}{(i+1)!} \frac{d^i a}{dt^i} \left( \frac{d^i x}{dt^i} \right)^{i+1}$$

(6)[2]

This is Newton’s second law in generalized. it similar to the formula of inertia in The difficulting of inertial in classical mechanics.

**Divice of Experiment**

In this experiment, first, it need a gravimeter, it can measurement the vary of gravitation but that is danger because the sensor can produce the current that is alternating if it in the system of acceleration. So that, it can be induct out the magnetic field in the conductor, it lead to short-circuit in the conductor, so that the conductor can be explosion, so only measure one set of data in every day. Second, it need a crown block (it tale chuck) it can be fixed on the wall as far as possible make the crown block had the potential energy of gravity. Thirth, it need a rope and make it accross the crown block, it make a site fixed the sensor, and another site make fixed the counterweight.

In the figure 1, the crown block is place on the wall that is high, the rope is cross the crown block and make a site fixed the sensor, and another site make fixed the counterweight, the counterweight it maked the sensor produce the acceleration, at the same time, for the display of value of gravitation on gravimeter, observed the value of display, it can proved the inertial is depend on acceleration if the value is vary.
Figure 1. Schematic of experiment of inertial of acceleration

Attention, don’t put the counterweight on the sensor, that is due to the sensor accepted the inertial force that is produce the accelerate. It can produce by error if a counterweight put on the sensor. But it for the counterweight have not requires in this site, so the mass is any value. The value of display is different if the counterweight is different, this is a evidence of inertia is depend on acceleration.

Data of Experiment

Because of the constraint of condition, the experiment is humble, and only detection set of data in every day. Due to the disability of me, this process of experiment is become to difficult. Though many days, only get two sets of data.

This is first site of data:

| $m(G)$ | $g = a$ | $\Delta G = f_i$ |
|--------|---------|-----------------|
| 0.1kg(1N) | $10\, (m/\, s^2)$ | $0\, N$ |
| 0.05kg(0.5N) | $10\, (m/\, s^2)$ | $0\, N$ |

In this experiment, the inertial force is a metric of inertia, it equivalence to the variable of gravitation. According to these sets of data, inertia have nothing to the mass. According to the (1.6), it obey to the vary of zero order to Newton’s second law in generalized. It change the acceleration too, if the motion stop in suddenly.

| $m(G)$ | $\Delta a$ | $\Delta G = f_i$ |
|--------|------------|-----------------|
| 0.1kg(1N) | $10\, m/\, s^3$ | $1\, N$ |
Contrast this two sites of data, our discover the inertia force have noting to the acceleration , and relation to the variable of order of acceleration.

**Inference of Experiment**

Well known, the object had different of velocity in falling free if it in medium of different. The object had different acceleration of falling in different midium. According to these two sets of data, inertial force of object in falling free only depeng on the variable of acceleration. So the value on the display is a variable. The variable of value on the display can be vary that is continuous if the object of falling in the medium that is vary of continuous too.

According to second law of Newton, if the mass is constant and the acceleration is variable, the inertial force is variable, it obey to the second law of Newton of generalized. This experiment is obey to (4) too, so the inertial force is performance for the work of virtual [3] (in fact, that is from the inertial force). At the this situation, the sensor is in the system of accelerated, so it accepted the inertial force. According to the principle of equivalence, it can change the value on the display of gravimeter.

**Choose the reference system of static**

In the reference system of static, the value on the display is a constant, that is due to this system had not the inertial force. For this kind system , it have not the acceleration , but it equivalence to a system of falling free if it have the size of infinitesimal and had not rotation , so this is a kind of reference system of static too , the acceleration of gravity is a kind of acceleration of virtual . So the work of gravity is a kind of work of virtual, it make the curved of spacetime, this thought is in general relativity.

According to the principle of work of virtual , have not the potential energy of gravity in reference system of static , so it is flat spacetime [4], for example , the spacetime of Minkowski is a kind of flat spacetime , in this spacetime , the potential energy of gravity can be disappear . In fact, the truly space is curved that is due to had the high-density celestial bodies and the size is small in the universe , it make the curved of spacetime and that is strong . So it produced the inertial force and do the work of virtual. So the reference system of static is only set up in a area of infinitesimal and it has not the inertial force in this area.

**Origin of Mass**

The mass is a intrinsic property of fundamental in universe, it depend on the density in space of unit. According to the model of universe in modern , the effect of quantum fluctuation is very strong in early universe[5], it make the some particles to be gather , this is origin of mass .

At the this time, the material to become the material of electrically neutral, it can proformance a kind of attribult:"mass". Attention, this is gravitational mass. After that, the material (particles) had thermal motion, and performance to curved of space, that is inertial mass, they are equivalence if the particle is static. So the mass is orgin to effect of quantum fluctuation in early universe [6].

**Conclusion**

To sum up, the size of value of inertia is depend on the size of value of acceleration and nothing to do the direction of acceleration. obviously, it a scalar , but it over the range of claasical mechanicie . It can metric the curved of spacetime, so it can metric the gravitational wawes.

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