Non Linear Relation: the Design of Deriving Physical Equations and Distributing Them with 3D Modeling

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Abstract: In this paper, the physical equation is used to derive the formula and then explore. It is found that there is a certain relationship between the formula and the solution value, and the three-dimensional space can be used to distribute them to design the structure diagram, so as to model to express the nonlinear relationship between them. Its innovation lies in that on the basis of the three-dimensional relationship, it is supposed to design a "three-dimensional" columnar object to establish the relationship between the distribution of their affiliations, so as to promote the establishment of physical equations in the three-dimensional spatial relationship method, and strengthen the understanding of physical equations so that they can be better used.

1. Introduction

The derivation of physical equations has become a new evolution formula, which has had a certain impact on the educates. For example, it has affected the derivation of physical equations, the confusion of equation relations after derivation and evolution, and the calculation relying on individual equations. For this reason, the equation corresponding to the solution value is derived from the physical equation, [1-2]which is distributed in each corner according to the three-dimensional spatial structure model to connect the relationship between the solution value corresponding formula, so that people can understand an objective relationship of the physical equation, that is the establishment of the physical equation in the three-dimensional spatial structure model relationship, [3-4]but also reflects the simplified model of the physical equation relationship, so that it can be used at a glance.

2. Material and Methods

(Variable speed motion, variable speed motion particle coordinate, velocity change with coordinate, vertical upthrow motion and free fall motion) formula derivation solution value [5].

2.1. The Speed of Variable Speed Motion, the Coordinate of Variable Speed Motion Particle and the Velocity Change with the Coordinate (Table 1, Table 2, Table 3 and Table 4 are as follows).

2.1.1. The Original Formula

Table 1 Variable-speed motion velocity, particle coordinates of variable-speed motion and the formula of velocity change with coordinates

Variable speed of motion	$v = v_0 + at$
Coordinate of particle in variable speed motion	$x = x_0 + vt + \frac{1}{2}at^2$
The velocity varies with the coordinates	$v^2 - v_0^2 = 2a(x - x_0)$

2.1.2. Derive the Formula

Find a

$$v = v_0 + at(1)$$

Derived

$$\frac{(v-v_0)}{t}(2)$$

Find a

$$x = x_0 + vt + \frac{1}{2}at^2(3)$$

Derived

$$\frac{2(x-x_0-v_0t)}{t^2}(4)$$

Find a

$$v^2 - v_0^2 = 2a(x - x_0)(5)$$

Derived

$$\frac{(v^2-v_0^2)}{2(x-x_0)}(6)$$

2.2. Vertical Throwing Movement

2.2.1. The Original Formula

Table 2 Formula for the motion of the vertical upward throw

Vertical throwing movement	$v = v_0 - gt$
	$y = v_0t - \frac{1}{2}gt^2$
	$v^2 = v_0^2 - 2gy$

2.2.2. Derive the Formula

Find g

$$v = v_0 - gt(7)$$

Derived

$$\frac{(v_0-v)}{t}(8)$$

Find g

$$y = v_0t - \frac{1}{2}gt^2(9)$$

Derived

$$\frac{2(v_0t-y)}{t^2}(10)$$

Find g

$$v^2 = v_0^2 - 2gy(11)$$

Derived

$$\frac{(v_0^2-v^2)}{2y}(12)$$

2.3. Free Fall Movement

2.3.1. The Original Formula

Table 3 Formula for free fall motion

Free fall movement	$y = \frac{1}{2}at^2$
	$v = gt$
	$v^2 = 2gy$

2.3.2. Derive the Formula

Find a

$$y = \frac{1}{2}at^2 \quad (13)$$

Derived

$$\frac{2y}{t^2} \quad (14)$$

Find g

$$v = gt \quad (15)$$

Derived

$$\frac{v}{t} \quad (16)$$

Find g

$$v^2 = 2gy \quad (17)$$

Derived

$$\frac{v^2}{2y} \quad (18)$$

Results

The design of triangle relation and coordinate by using three dimensional space,see the following Figure 1 Triangular relation spatial structure distribution design diagram and Table 4 Three dimensional space set up coordinate design summary below.

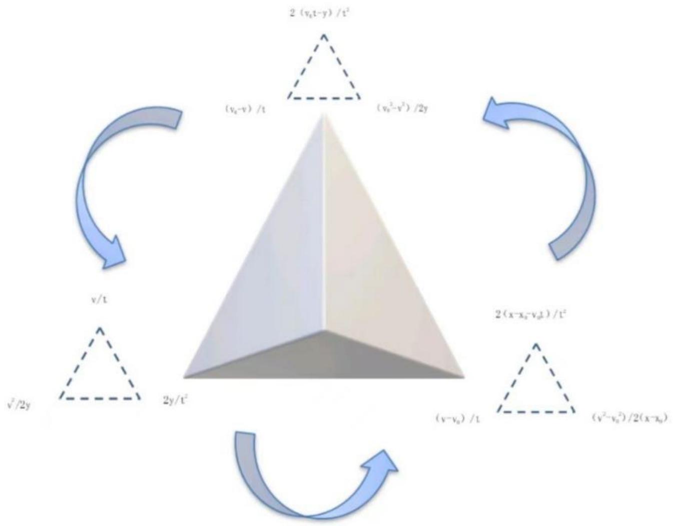

Figure 1 Triangular relation spatial structure distribution design diagram

Table 4 Three dimensional space set up coordinate design summary

Variable speed motion velocity, variable speed motion particle coordinate and velocity change formula with coordinate	$\frac{(v - v_0)}{t}$ Let's say the coordinates are 1, 0, 0.	$\frac{(v^2 - v_0^2)}{2(x - x_0)}$ Let's say the coordinates are 0, 1, 0.	$\frac{2(x - x_0 - v_0t)}{t^2}$ Let's say the coordinates are 0, 0, 0.
The formula for vertical upthrow motion	$\frac{(v_0 - v)}{t}$ Let's say the coordinates are 1, 0, 2.	$\frac{(v_0^2 - v^2)}{2y}$ Let's say the coordinates are 0, 1, 2.	$\frac{2(v_0t - y)}{t^2}$ Let's say the coordinates are 0, 0, 2.
Formula for free fall	$\frac{2y}{t^2}$ Let's say the coordinates are 0, 1, 1.	$\frac{v}{t}$ Let's say the coordinates are 0, 0, 1.	$\frac{v^2}{2y}$ Let's say the coordinates are 1, 0, 1.

3. Discuss

Model 1: Suppose that a three-dimensional nonlinear relationship is established between the formula and the solution value - Take table 4 as an example

3.1. Establish the Nonlinear Relationship between Region a, Region a and Regiong g, and Regiong g.

3.1.1. Set Up the Nonlinear Relation of Region g (Variable Velocity, Variable Velocity Particle Coordinate and Velocity Change Formula with Coordinate)

We know that the original expression $v = v_0 + at$contains a, and $x = x_0 + vt + \frac{1}{2}at^2$ I have a, I have $v^2 - v_0^2 = 2a(x - x_0)$ contains a;

The formula $v = v_0 + at \in$ a and $x = x_0 + vt + \frac{1}{2}at^2 \in$ a and $v^2 - v_0^2 = 2a(x - x_0) \in$ a;

According to the relationship between the three formulas and a, the formula for solving a is derived from the relationship between the three formulas and a, so as to design a nonlinear structure diagram [6-7].

Discussion and evaluation

Inference that the equations solved by a are related to these equations assume that $S_a = \frac{(1\times1)}{2}$ =0.5, the area of a is 0.5, and the corresponding coordinates of the formula are successively followed by

$\frac{(v-v_0)}{t}$@(1,0,0);$\frac{(v^2-v_0^2)}{2(x-x_0)}$@(0,1,0);$\frac{2(x-x_0-v_0t)}{t^2}$@(0, 0, 0), and then imagine these three expressions at the three points of a, which are X-shaft 1, Y-shaft 1, and Z-shaft 0 respectively. So the side $\{\frac{2(x-x_0-v_0t)}{t^2}$ & $\frac{(v-v_0)}{t}\}$=1;Side $\{\frac{2(x-x_0-v_0t)}{t^2}$ & $\frac{(v^2-v_0^2)}{2(x-x_0)}\}$=1.Available $S_{\{\frac{(v-v_0)}{t} \cup \frac{(v^2-v_0^2)}{2(x-x_0)} \cup \frac{2(x-x_0-v_0t)}{t^2}\}} = \frac{(1\times1)}{2}$ =0.5.

The resulting

$s_a = S_{\{\frac{(v-v_0)}{t} \cup \frac{(v^2-v_0^2)}{2(x-x_0)} \cup \frac{2(x-x_0-v_0t)}{t^2}\}}$, which leads to $\{\frac{(v-v_0)}{t} \cup \frac{(v^2-v_0^2)}{2(x-x_0)} \cup \frac{2(x-x_0-v_0t)}{t^2}\}$ contains a. And because $\{\frac{(v-v_0)}{t} \cup \frac{(v^2-v_0^2)}{2(x-x_0)} \cup \frac{2(x-x_0-v_0t)}{t^2}\}$ is the formula for a, so the nonlinear trigonometric relation of a is valid.

3.1.2 Set Up Nonlinear Relation between a and g Region (Free Fall Motion Formula)

The original formula $y = \frac{1}{2}at^2$ is known it contains a, $v = gt$ contains g, $v^2 = 2gy$ contains g; Apply the formula $y = \frac{1}{2}at^2 \in$ a, $v = gt \in$ g, $v^2 = 2gy \in$ g equal a and g region distribution;

According to the relationship between a and g and the three formulas, deduce the formulas of a and g to design a nonlinear structure diagram.

Discussion and evaluation

Inference that the equations solved by a and g are related to these equations

Assume that $S_{a\ and\ g} = \frac{(1\times1)}{2}$ =0.5, the area of a and g is 0.5, and the corresponding coordinates of the formula are respectively $\frac{2y}{t^2}$@(0,1,1); $\frac{v}{t}$@ (0,0,1); $\frac{v^2}{2y}$@(1, 0, 1), and then imagine these three expressions at the three points of a and g, which are X-shaft 1, Y-shaft 1 and Z-shaft 1 respectively. So the edge $\{\frac{2y}{t^2}$ & $\frac{v}{t}\}$=1; $\{\frac{v^2}{2y}$ & $\frac{v}{t}\}$=1. Available $S_{\{\frac{2y}{t^2} \cup \frac{v}{t} \cup \frac{v^2}{2y} \cup \frac{v}{t}\}} = \frac{(1\times1)}{2}$ =0.5.

The resulting

$s_{a\ and\ g} = S_{\{\frac{2y}{t^2} \cup \frac{v}{t} \cup \frac{v^2}{2y} \cup \frac{v}{t}\}}$, which leads to $\{\frac{2y}{t^2} \cup \frac{v}{t} \cup \frac{v^2}{2y} \cup \frac{v}{t}\}$ includes a and g. And because $\{\frac{2y}{t^2} \cup \frac{v}{t} \cup \frac{v^2}{2y} \cup \frac{v}{t}\}$ is a nonlinear trigonometry for a and g.

3.1.3 Establishment of g Region Nonlinear Relation (Vertical Upthrow Motion Formula)

The original formula $v = v_0 - gt$ contains g, $y = v_0 t - \frac{1}{2} g t^2$ is equal to Contains g, $v^2 = v_0^2 - 2gy$ contains g; The formula $v = v_0 - gt \in$ g, $y = v_0 t - \frac{1}{2} g t^2 \in$ g, $v^2 = v_0^2 - 2gy \in$ g equal g region distribution;

According to the relationship between g and the three formulas, the formula for g is derived to design a nonlinear structure diagram.

Discussion and evaluation reasoning that the solution formulas of g are related to these formulas assume that $S_g = \frac{(1\times1)}{2}$ =0.5, the area of g is 0.5, and the corresponding coordinates of the formula are successively followed by $\frac{(v_0-v)}{t}$@(1,0,2);$\frac{(v_0^2-v^2)}{2y}$@(0,1,2);$\frac{2(v_0 t-y)}{t^2}$(0,0,2), and then imagine these three expressions at the three points of g, which are x-shaft 1, Y-shaft 1 and z-shaft 2 respectively. So the edge $\{\frac{(v_0-v)}{t}$ & $\frac{2(v_0 t-y)}{t^2}\}$=1;$\{\frac{(v_0^2-v^2)}{2y}$ & $\frac{2(v_0 t-y)}{t^2}\}$=1. Available $S_{\{\frac{(v_0-v)}{t} \cup \frac{2(v_0 t-y)}{t^2} \cup \frac{(v_0^2-v^2)}{2y}\}} = \frac{(1\times1)}{2}$ =0.5.

The resulting $s_g = S_{\{\frac{(v_0-v)}{t} \cup \frac{2(v_0 t-y)}{t^2} \cup \frac{(v_0^2-v^2)}{2y}\}}$, which leads to $\{\frac{(v_0-v)}{t} \cup \frac{2(v_0 t-y)}{t^2} \cup \frac{(v_0^2-v^2)}{2y}\}$ contains g. And because $\{\frac{(v_0-v)}{t} \cup \frac{2(v_0 t-y)}{t^2} \cup \frac{(v_0^2-v^2)}{2y}\}$ is the formula for g, so the nonlinear trigonometric relation of g is valid.

3.2. According To the Content Described In "(I)" Above, Design the SCHEMATIC Diagram of 3D Modeling Relationship between the Corresponding Subordinate Region and the Formula, the Design of the Distribution of the Formula Relations in Three-Dimensional Space is Beneficial to Dredge the Formula Relations, and the Derivation of Mathematical Formulas is Also a Concern for Current Education (See the Following Figure 2 3D distribution diagram of variable-speed motion velocity, particle coordinates of variable-speed motion and velocity variation with coordinates, Figure 3 3D distribution of free-fall motion, Figure 4 3D distribution of vertical upcasting motion and Figure 5 Design drawing of nonlinear distribution simulation of triangular prism below).

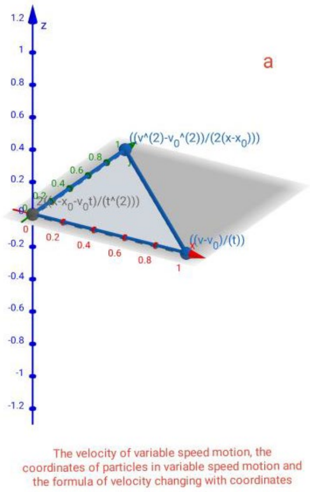

Figure 2 3D distribution diagram of variable-speed motion velocity, particle coordinates of variable-speed motion and velocity variation with coordinates

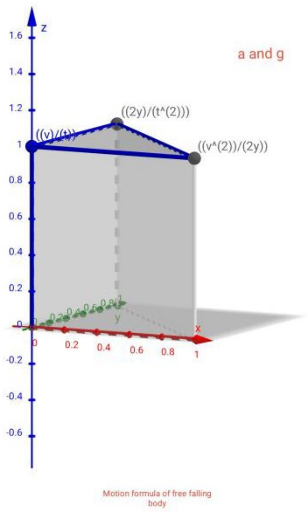

Figure 3 3D distribution of free-fall motion

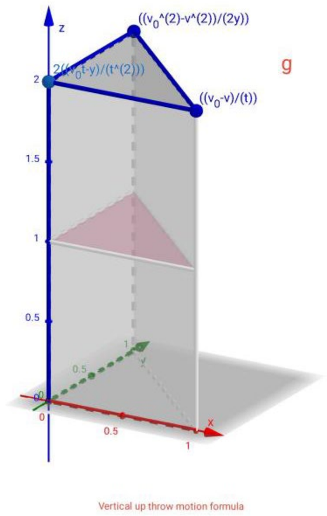

Figure 4 3D distribution of vertical upcasting motion

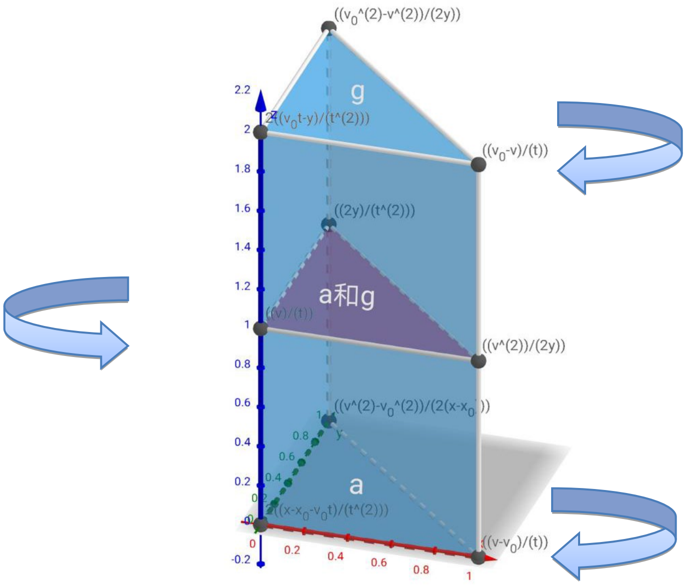

Figure 5 Design drawing of nonlinear distribution simulation of triangular prism

Model 2: The relationship between variable velocity, variable velocity particle coordinate, velocity change with coordinate, vertical upthrow motion and free fall motion is established by using the formula [8-10].

3.3. The Following Formula Analysis

3.3.1. Analyze a Module

a $\in$ $v = v_0 + at$, a $\in x = x_0 + vt + \frac{1}{2}at^2$, a $\in$ $v^2 - v_0^2 = 2a(x - x_0)$ and $v = v_0 + at$ contains a, $x = x_0 + vt + \frac{1}{2}at^2$ Contains a and $v^2 - v_0^2 = 2a(x - x_0)$ contains a, and the formula for the solution value of a is derived as $\frac{(v-v_0)}{t}$, $\frac{2(x-x_0-v_0t)}{t^2}$ and $\frac{(v^2-v_0^2)}{2(x-x_0)}$, so:

$|\frac{(v-v_0)}{t} \cup \frac{2(x-x_0-v_0t)}{t^2} \cup \frac{(v^2-v_0^2)}{2(x-x_0)}| \cap$ a = a, it is reduced to solve the value of a module.

3.3.2. Analyze a and g Modules

a $\in y = \frac{1}{2}at^2$, g $\in v = gt$, g $\in v^2 = 2gy$ and $y = \frac{1}{2}at^2$ contains a, $v = gt$ contains g, $v^2 = 2gy$ contains g, and the formula of solution values a and g is deduced to be $\frac{2y}{t^2}, \frac{v}{t}, \frac{v^2}{2y}$, so we can get:

$|\frac{v}{t} \cup \frac{v^2}{2y}| \cap$ g = g or $|\frac{2y}{t^2}| \cap$ a = a, so as to solve the value of a and g module.

3.3.3. Analyze g Module

g $\in v = v_0 - gt$, g $\in y = v_0t - \frac{1}{2}gt^2$, g $\in v^2 = v_0^2 - 2gy$ and $v = v_0 - gt$ contains g,$y = v_0t - \frac{1}{2}gt^2$ contains g and $v^2 = v_0^2 - 2gy$ contains g, and the formula of the solution value g is derived as $\frac{(v_0-v)}{t}, \frac{2(v_0t-y)}{t^2}, \frac{(v_0^2-v^2)}{2y}$, so:

$|\frac{(v_0-v)}{t} \cup \frac{2(v_0t-y)}{t^2} \cup \frac{(v_0^2-v^2)}{2y}| \cap$ g = g, so as to solve the value g module.

3.4. According to the Content Described in "(I)" Above, Design the SCHEMATIC Diagram of 3D Modeling Relationship Between the Corresponding Subordinate Region and the Formula, The Integration and Induction of the Corresponding Derivation Formula Between the Solution Value and the above Solution Value can not only Clearly Understand the Relationship Between the Solution Value and the Formula, but also Establish Necessary and Sufficient Conditions on the Relation Between the Derivation and the Formula (see the following figure 6 Three module area 3D distribution design drawing below).

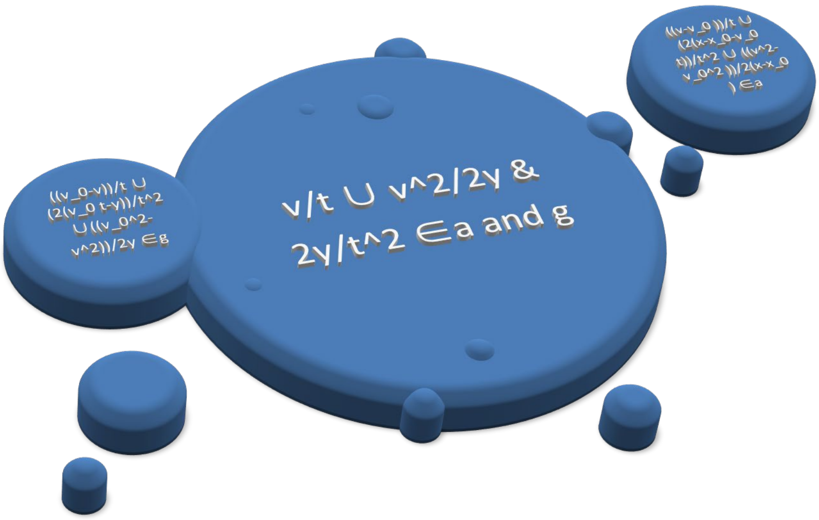

Figure 6 Three module area 3D distribution design drawing

4. Conclusion

Comprehensive model 1: the distribution design of formula sub relations in three-dimensional space is beneficial to dredging the formula sub relations. The derivation of mathematical formulas is also a concern for current education. As far as the physical equation relationship diagram is concerned, people can become more interested in numbers. The physical equation should not only be calculated and derived on the book, but also establish a non-linear or linear structural relationship diagram between the formula and solution value of its affiliated area and the three-dimensional space, Based on this design, it can greatly improve the cognitive law of physical equations, the method of calculating each value, deepen the memory of formulas and the composition of rational formula sub relations, and further apply and develop in the combination of arithmetic with three-dimensional structure diagram.

Comprehensive model 2: integrate and summarize the corresponding derivation formulas with the above solution values, so that the relationship between the solution values and the formula can be clearly known, and the necessary and sufficient conditions can be erected on the relationship between the derivation of the formula. By summarizing the relationship between the solution value and the formula in this way, the derivation of the formula is calculated so that it can be solved on the formula of each value, and it is also an optimization to reflect the relationship between the solution value and the formula in three dimensions.

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