Introducing Viewpoints of Mechanics into Basic Growth Analysis (5) : Problems Derived from Introducing Growth Jerk

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Introducing Viewpoints of Mechanics into Basic Growth Analysis
– (V) Problems Derived from Introducing Growth Jerk –

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The present study was designed to investigate problems derived from introducing growth jerk into basic growth analysis. The results obtained were as follows. The growth jerk, which was given by the third derivative of weight in basic growth function, gave a case of wave function described using complex numbers in exponential function with base e. Applying Lorentz transformation to time in wave function led to an inclusion of velocity of an object as well as relative growth rate of weight. This confusing coexistence of motion and growth factors in the world of complex numbers was a mysterious phenomenon that was very difficult to interpret, when compared with wave function in quantum mechanics that does not include a growth factor. This chaotic property of wave function in the present study, if it was received hypothetically, might be related to mysterious and symmetric properties of Euler's formula existing at the back of many things in nature. However, whether this chaotic coexistence is acceptable or not should be elucidated.

INTRODUCTION

I investigated, in a paper (Shimojo, 2006b), jerk of growth given by the third derivative of weight in basic growth function, the rate of change of growth acceleration (Jerk, 2006). In dealing with growth jerk, there appears wave function that is described using complex numbers in exponential function with base e (Shimojo, 2006b). It is known that wave function with complex numbers is used in quantum mechanics (French and Taylor, 1978b). Comparing these two different wave functions suggested that relative growth rate of weight in growth mechanics was interpreted as energy (Shimojo, 2006b) in the superficial resemblance to equation of energy in quantum mechanics (French and Taylor, 1978b). However, I am puzzled by differences and hypothetic resemblances between growth mechanics and quantum mechanics. There seems to be further problems in the issue of growth jerk.

The present study was designed to investigate further problems derived from introducing growth jerk into basic growth analysis.

PROBLEMS DERIVED FROM INTRODUCING GROWTH JERK

Growth jerk in basic growth analysis

The weight of an animal or a plant in basic growth analysis is given by

$$W = W_0 \exp(\text{RGR } t), \tag{1}$$

where $W =$ weight, $t =$ time, RGR $=$ relative growth rate, $W_0 =$ the weight at $t = 0$.
When a person measures the weight of an animal or a plant, they are at rest without a relative motion. Equation (1) for W includes time, but does not include space as a variable. The increase in weight with the passage of time implies an increase in the volume of a body, a thing that is associated with space but is not described in equation (1).

The differentiation of W with respect to t gives absolute growth rate (AGR),

$$\text{AGR} = \frac{dW}{dt} = W_0 \text{ RGR } \exp(\text{RGR } t). \tag{2}$$

The differentiation of AGR with respect to t gives growth acceleration (GA),

$$\text{GA} = \frac{d(\text{AGR})}{dt} = W_0 (\text{RGR})^2 \exp(\text{RGR } t). \tag{3}$$

The differentiation of GA with respect to t gives growth jerk (GJ),

$$\text{GJ} = \frac{d(\text{GA})}{dt} = W_0 (\text{RGR})^3 \exp(\text{RGR } t). \tag{4}$$

Relating W, AGR, GA and GJ

Relating equations (1) – (4) leads to

$$\frac{\text{AGR}}{W} = \frac{\text{GA}}{\text{AGR}} = \frac{\text{GJ}}{\text{GA}} = \text{RGR}. \tag{5}$$

Relating the second and third terms in (5) gives

$$(\text{GA})^2 = \text{AGR} \cdot \text{GJ}. \tag{6}$$

As shown in the previous report (Shimojo, 2006b), GA is given by extracting the square root of AGR·GJ, taking positive and negative values from the viewpoint of mathematics. Thus,

$$\text{GA} = \pm \sqrt{\text{AGR} \cdot \text{GJ}}$$

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$\pm \ \overline{(W_0 \ (\text{RGR}) \ \exp(\text{RGR} \ t)) \ (W_0 \ (\text{RGR})^3 \ \exp(\text{RGR} \ t))}$

$\pm \ \overline{(W_0)^2 \ (\text{RGR})^4 \ (\exp(\text{RGR} \ t))^2}$

$\pm \ (W_0) \ (\text{RGR})^2 \ \exp(\text{RGR} \ t).$ (7)

In equation (7) $\pm$ sign is given globally to the right–hand side. Mathematical contradictions occur if locally giving is taken up in order to provide $\pm$ sign for each of the three terms. However, new aspects are derived from growth mechanics, provided that these contradictions are solved.

Locally giving $\pm$ sign to the right–hand side of equation (7)

There are two cases according to the previous report (Shimojo, 2006b).
(A) Giving $\pm$ sign to W_0 or to $\exp(\text{RGR} \ t)$
This is as follows:

GA $(\pm W_0) \ (\text{RGR})^2 \ \exp(\text{RGR} \ t)$, (8) or

GA $(W_0) \ (\text{RGR})^2 \ (\pm \exp(\text{RGR} \ t))$. (9)

Since W_0 and $\exp(\text{RGR} \ t)$ are related by the product form in equation (1), the phenomenon caused by $\pm$ sign is the same between equations (8) and (9). Thus, equation (8) only is taken up. Equation (8) is contradictory to equation (1) due to the inclusion of $-W_0$. Therefore, the following modification of equation (1) is required in order to solve this contradiction,

$W \ (\pm W_0) \ \exp(\text{RGR} \ t)$. (10)

The second derivative of equation (10) gives equations (8) and (9), solving the contradiction.
What $-W_0$ means in equation (10) was shown by Shimojo *et al.* (2006a) and Shimojo (2007).

(B) Giving $\pm$ sign to $(\text{RGR})^2$
This is as follows:

GA $(W_0) \ (\pm (\text{RGR})^2) \ \exp(\text{RGR} \ t)$, (11)

The problem is the existence of $-\text{RGR}^2$ because of contradicting the principle of differential in the exponential function with base e. I have to take up complex numbers, if $-\text{RGR}^2$ is accepted. Therefore, equation (1) is replaced by

$W \ W_0 \ \exp((\pm \ \boldsymbol{i} \ \text{RGR}) \ t)$, (12)

where $\boldsymbol{i}$ imaginary unit.
The second derivative of equation (12) gives

$\dfrac{d^2W}{dt^2} \ W_0 \ (-\text{RGR})^2 \ \exp((\pm \ \boldsymbol{i} \ \text{RGR}) \ t)$. (13)

The contradiction caused by $-\text{RGR}^2$ in equation (11) may be solved by equations (12) and (13) in spite of gaps in the process of solution. Equation (12) is far from the growth analysis of animals and plants due to the existence of $\boldsymbol{i}$. However, I would like to stick to this equation due to still including RGR.

Properties of equation (12)

Equation (12), which belongs to the world of complex numbers with a leap from real numbers, shows waves, as shown by Euler's formula:

$W \ W_0 \ \exp((\pm \ \boldsymbol{i} \ \text{RGR}) \ t)$

$W_0 \ (\cos(\text{RGR} \ t) \pm \ \boldsymbol{i} \ \sin(\text{RGR} \ t))$. (14)

Since there is a close relationship between time and space, Lorentz transformation for time was introduced into sine curve describing waves (French and Taylor, 1978a). Applying this procedure to equation (12), even if it is based on equation (14), is a reckless attempt that is very difficult to interpret. However, imagining what occurs in this application at the risk of making mistakes seems to be of interest, because the world of complex numbers is full of mysteries. Lorentz transformation for time between two coordinate systems t and t' (French and Taylor, 1978a) is given by

$t' \ \dfrac{t - (v/c^2) \ x}{\sqrt{1-(v/c)^2}}$. (15)

In equation (15) c velocity of light, v and x are interpreted later.

Applying equation (15) to equation (12) where t has been replaced by t' beforehand gives

$W \ W_0 \ \exp\left((\pm \ \boldsymbol{i} \ \text{RGR}) \ \dfrac{t - (v/c^2) \ x}{\sqrt{1-(v/c)^2}}\right)$. (16)

The term with minus sign in equation (16) is taken up and transformed hypothetically as follows,

$W \ W_0 \ \exp\left((- \ \boldsymbol{i} \ \text{RGR}) \ \dfrac{t - (v/c^2) \ x}{\sqrt{1-(v/c)^2}}\right)$

$W_0 \ \exp\left(\boldsymbol{i} \ \dfrac{\text{RGR} \ (v/c^2)}{1- (v/c)^2} \ x - \boldsymbol{i} \ \dfrac{\text{RGR}}{1- (v/c)^2} \ t\right)$. (17)

Here I would like to take up the wave equation that is used in quantum mechanics, as shown, for example, by French and Taylor (1978b),

$A \ \exp(\boldsymbol{i} \ \dfrac{p}{\hbar} \ x - \boldsymbol{i} \ \dfrac{E}{\hbar} \ t)$, (18)

where wave function, $\boldsymbol{i}$ imaginary unit, $\hbar \ h/2$ (h: Planck's constant, : circular constant), p momentum, E energy.

Equation (17) is different from equation (18). Roughly speaking, however, there might be a superficial resemblance in the form between equations (17) and (18). If this resemblance is received at the risk of making mistakes, then v might be the velocity of an object moving along the coordinate axis of x. However, this confusing coexistence of RGR of weight and v of an object in equation (17) is very difficult to interpret, a chaos that seems to be incomprehensible or unacceptable.

Discussion

The present study takes up problems that are very difficult to interpret from the viewpoint of mechanics. They are: (1) the application of Lorentz transformation for time to wave function that is derived hypothetically from introducing growth jerk into basic growth analysis [equation (16)], (2) the division of Lorentz transformation for time into two parts: coordinate axis of t and that of x [equations (17)], (3) comparing the hypothetic wave function derived from growth mechanics and the wave function in quantum mechanics.

Equation (17), which is hypothetically constructed, takes the form of wave function including not only velocity of an object but also relative growth rate of weight. This chaotic coexistence is very difficult to interpret. Although motion and growth are different things, the confusing coexistence of them in the world of complex numbers might be related to mysterious and symmetric properties of Euler's formula that may exist at the back of many things in nature. It is not known, however, whether concepts and procedures in the present study are acceptable or not. If they do not seem to be unacceptable, what equation (17) implies should be examined in further studies.

Conclusions

Introducing growth jerk into basic growth analysis gave wave function including relative growth rate in the world of complex numbers. Applying Lorentz transformation for time to this wave function led to an inclusion of velocity of an object as well as relative growth rate of weight. However, whether this chaotic coexistence is acceptable or not should be elucidated.

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