*Journal of Physical Education and Sport* ® (JPES), Vol 19 (Supplement issue 2), Art 55, pp 369 - 375, 2019
online ISSN: 2247 - 806X; p-ISSN: 2247 – 8051; ISSN - L = 2247 - 8051 © JPES

**Original Article**

# Evaluation of theory mathematics and mechanics modeling of velocity function of time via the applied force time-dependent cosine oscillation of Usain Bolt in 100 meter sprint

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Published online:Februry 28, 2019
(Accepted for publication January 28, 2019)
**DOI:10.7752/jpes.2019.s2055**

**Abstract.** In our research paper, we will improve the Aunchana C. et al. mathematical and physics model 1 and model 2 for the velocity-time of Usain Bolt in the 100 m sprint at the Beijing Olympic games 2008, Berlin world championships in Athletics 2009, and London Olympic in 2012 to made the equation more accurately. We will compare the result with the velocity and time from the experiment of K.Mackata and M.Antti and we will compare the correlation coefficient value obtained from our equation with the Aunchana C. et al. mathematical and physics model 1 and model 2 correlation coefficient value to analyze which is the best models. Next, we will use the data obtained from our equation to shown the power of the sprinter and kinetic energy in a form of graph and analyze the result.
**Keyword:** Usain Bolt, the applied force time-dependent Cosine oscillator, Correlation of Physics model

## Introduction

Everyone know that the running is a good way to stay in shape. The simplicity of running appeals to many people. You don't need a lot of complicated or expensive equipment; you just need a good pair of running shoes. Some researcher suggest that perhaps you do not need shoes at all. In this day. Running isn't just an exercise anymore. But it's a very well-known sport that a lot of people around the world give an attention that many people watch the competition as much as other well-known sport. There is a lot of talented sprinter all around the world but there is one very special talented person. His name is Usain Bolt, a Jamaican sprinter. He is the first person to hold both 100 meters and 200 meters world records. He is very fast that attract a lot of scientist to study about his performance[2,3,4]. Such as, O.Helene and M.T.Yamshita research shows Usain Bolt's maximum time-dependence velocity, acceleration and power at Beijing 2008 and at berlin 2009[5], Mackala Krzsztof, Antti Mero et al. research was to compare and consider the relevance of the morphological characteristics and Variance of running speed parameters (stride length and stride frequency)[7] and Aunchana et al. research expand a theory about the mathematical and physics models for the velocity-time of Usain-bolt in the 100 m sprint during the Beijing Olympic games 2008, Berlin world championships in athletics 2009,and London Olympic in 2012[11,7]. In our research. We are interested in Aunchana. Et al. research. We try to expand some theory to make the equation more accurate and closer to the data from Mackata Krzsztof, Antti Mero et al. research. We will use the data that obtained from our equation to plot graph the power of the sprinter and kinetic energy.

## 2. Theory of Mathematics

2.1. Derivation of the formula for integration by parts

We already know how to differentiate a product: if $y(x)=u(x)v(x)$. Then

$$\frac{dy}{dx}=\frac{d\left(u(x)v(x)\right)}{dx}=u(x)\frac{dv(x)}{dx}+\frac{du(x)}{dx}v(x). \qquad (1)$$

Rearranging this rule

$$u(x)\frac{dv(x)}{dx}=\frac{d\left(u(x)v(x)\right)}{dx}-\frac{du(x)}{dx}v(x). \qquad (2)$$

The first term on the right hand sides simplifies since we are simply integration what has been differentiated

$$\int u(x)dv(x)=u(x)v(x)-\int v(x)du(x) \qquad (3)$$


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This the formula known as integration by parts. The formula replaces one integral (that on the left) with another (that on the right). The intention is that the one on the right is a simpler integral to evaluate, as we shall see in the section 3.

2.2. First-order linear equations

A first-order linear differential equation is one that can be written in the form

$$\frac{dy}{dx}+P(x)y=Q(x), \tag{4}$$

where $P(x)$ and $Q(x)$ are continuous functions of $x$. Equation (4) is the linear equation's standard form. We solve the equation (4) by multiplying both sides by a positive function $\sigma(x)$ that transforms the left-hand side into the derivative of the product $\sigma(x)\ y$. We will show how to find $\sigma$ in a moment, but first we want to show how, once found, it provides the solution we seek. Here is why multiplying by $\sigma(x)$ works.

$$\frac{d\left(\sigma(x)\ y\right)}{dx}=\sigma(x)Q(x) \tag{5}$$

then, we obtain the solution of equation (4)

$$y(x)=\frac{1}{\sigma(x)}\left(\int\sigma(x)\ Q(x)dx+C\right) \tag{6}$$

Equation (6) expresses the solution of Equation (4) in terms of the function $\sigma(x)$ and $Q(x)$. We call $\sigma(x)$ an integrating factor for Equation (4) because its presence makes the equation integrable. Why doesn't the formula for $P(x)$ appear in the solution as well? It does, but indirectly, in the construction of the positive function $\sigma(x)$. We have

$$\frac{d\left(\sigma(x)\ y(x)\right)}{dx}=\sigma(x)\frac{dy(x)}{dx}+\sigma(x)P(x)y(x).$$

This last equation will hold if $\frac{d\sigma(x)}{dx}=\sigma(x)P(x)$, we get

$$\sigma(x)=e^{\int P(x)\,dx} \tag{7}$$

Substituting the equation (7) into equation (6), We obtain the completed solution of equation (4) as

$$y(x)=e^{-\int P(x)\,dx}\left(\int e^{\int P(x)\,dx}\ Q(x)\ dx+C\right). \tag{8}$$

This the formula known as the completed solution of the non-homogeneous first-order linear differential equation. We will adapt it for using in the section 3

**3. Linear modeling the velocity time-dependence via the applied force time-dependent Cosine oscillation for Usain Bolt in the 100 meters sprint**

3.1 Evaluation of the model 1 velocity time-dependent via the applied force time-dependent Cosine oscillation.

We are presented in calculation method of velocity time-dependent the motion of a Jamaican sprinter, Usain Bolt, current 100 meters world itemize owner when the applied force is time-dependent Cosine oscillator; that is $F_1(t)=\frac{f_0}{\beta}te^{-\beta t}\cos^2(\omega t)$. The kinematic parameter $\beta$ is speed endurance of sprinter. Let us assume that the drag force is proportional to velocity. The equation of motion was written as[1,2]

$$\frac{dv_1(t)}{dt}+\frac{\kappa}{m}v_1(t)=\frac{f_0}{m\beta}te^{-\beta t}\cos^2(\omega t), \tag{9}$$

where we defined the coefficient drag force as $\kappa$. The equation (9) is non-homogeneous first-order linear differential equation. We evaluated the velocity time-dependent of the usain Bolt runner $v_1(t)$ as

$$v_1(t)=e^{-\int\frac{\kappa}{m}dt}\left(\int e^{\int\frac{\kappa}{m}dt}\ \frac{f_0}{\beta m}te^{-\beta t}\cos^2(\omega t)dt+C_1\right). \tag{10}$$

We defined the parameter $\delta$ as $\dfrac{\kappa}{m}-\beta$, we obtain

$$v_1(t)=e^{-\int\frac{\kappa}{m}dt}\left(\frac{f_0}{\beta m}\int te^{\delta t}\cos^2(\omega t)\,dt+C_1\right) \tag{11}$$

which on integration by parts method yields

$$u=t \qquad dv=e^{\delta t}\cos^2(\omega t)\,dt$$

$$du=dt \qquad v=\frac{e^{\delta t}}{2\delta}+\frac{2\omega e^{\delta t}\sin(2\omega t)+\delta e^{\delta t}\cos(2\omega t)}{2\left(\delta^2+4\omega^2\right)}$$

After rearranging

$$\begin{aligned}v_1(t)=&\frac{f_0te^{-\beta t}}{2\beta\delta m}+\frac{2f_0\omega te^{-\beta t}\sin(2\omega t)+f_0\delta e^{-\beta t}\cos(2\omega t)}{2\beta m\left(\delta^2+4\omega^2\right)}-\frac{f_0e^{-\beta t}}{2\beta\delta^2m}+e^{-\frac{\kappa}{m}t}C_1-\left(\frac{f_0\omega\delta e^{-\beta t}\sin(2\omega t)-2f_0\omega^2e^{-\beta t}\cos(2\omega t)}{\beta m\left(\delta^2+4\omega^2\right)^2}\right)\\&-\left(\frac{2f_0\delta\omega e^{-\beta t}\sin(2\omega t)+f_0\delta^2e^{-\beta t}\cos(2\omega t)}{\beta m\left(\delta^2+4\omega^2\right)^2}\right)\end{aligned} \tag{12}$$

Substituting for the initial velocity $v_1(0)=0$ in the equation (12), we get a new equation as the final velocity time-dependent model1 complete solution will be

$$\begin{aligned}v_1(t)=&\frac{f_0te^{-\beta t}}{2\beta m\left(\frac{\kappa}{m}-\beta\right)}+\frac{2f_0\omega te^{-\beta t}\sin(2\omega t)+f_0\left(\frac{\kappa}{m}-\beta\right)e^{-\beta t}\cos(2\omega t)}{2\beta m\left(\left(\frac{\kappa}{m}-\beta\right)^2+4\omega^2\right)}-\frac{f_0e^{-\beta t}}{2\beta m\left(\frac{\kappa}{m}-\beta\right)^2}\\&-\left(\frac{f_0\omega\left(\frac{\kappa}{m}-\beta\right)e^{-\beta t}\sin(2\omega t)-2f_0\omega^2e^{-\beta t}\cos(2\omega t)}{\beta m\left(\left(\frac{\kappa}{m}-\beta\right)^2+4\omega^2\right)^2}\right)-\left(\frac{2f_0\omega\left(\frac{\kappa}{m}-\beta\right)e^{-\beta t}\sin(2\omega t)+f_0\left(\frac{\kappa}{m}-\beta\right)^2e^{-\beta t}\cos(2\omega t)}{\beta m\left(\left(\frac{\kappa}{m}-\beta\right)^2+4\omega^2\right)^2}\right)\\&+e^{-\frac{\kappa}{m}t}\left(\frac{f_0}{2\beta m\left(\frac{\kappa}{m}-\beta\right)^2}+\frac{f_0\left(\frac{\kappa}{m}-\beta\right)^2}{\beta m\left(\left(\frac{\kappa}{m}-\beta\right)^2+4\omega^2\right)^2}-\frac{2f_0\omega^2}{\beta m\left(\left(\frac{\kappa}{m}-\beta\right)^2+4\omega^2\right)^2}\right)\end{aligned} \tag{13}$$

To solve the kinematic parameter $f_0$, $\beta$, $\kappa$ and $\omega$ of velocity time-dependent model1 in equation (13), we use it command the find fit model numerical. It's use illustrated in section of numerical and result

3.2 Calculation of the model2 velocity time-dependent by the applied force time-dependent Cosine oscillation

In this project, we are interested in studying the resistance of the drag was assumed to be commensurate to the velocity time-dependent and, the applied force Cosine oscillation model2. The equation of motion for Usain Bolt in the 100 metres sprint was written as

$$\frac{dv_2(t)}{dt}+\frac{\kappa}{m}v_2(t)=\frac{f_0}{m\beta^2}t^2e^{-\beta t}\cos^2(\omega t)\,. \tag{14}$$

We proposed that a sprinter's force decreases exponential-Cosine squares of time function with time according to $F_2(t)=\dfrac{f_0}{\beta^2}t^2e^{-\beta t}\cos^2(\omega t)$ so that the solution of equation (14) (Newton's second law[1,2]) is

$$v_2(t)=e^{-\frac{\kappa}{m}t}\left[\frac{f_0}{\beta^2m}\int t^2e^{-\delta t}\cos^2(\omega t)\,dt+C_2\right], \tag{15}$$

where $\delta=\dfrac{\kappa}{m}-\beta$ is the kinematics parameter. Let us consider the first term right side of equation (18), which, integration by parts, may be written as

$$\int t^2 e^{\delta t}\cos^2(\omega t)dt = \frac{t^2 e^{\delta t}}{2\delta} + \frac{2\omega t^2 e^{\delta t}\sin(2\omega t) + \delta t^2 e^{\delta t}\cos(2\omega t)}{2(\delta^2+4\omega^2)} - \frac{e^{\delta t}(t\delta-1)}{\delta^3}$$
$$-\frac{e^{\delta t}}{(\delta^2+4\omega^2)}\left(\frac{\left((t\delta^4-\delta^3+12\delta\omega^2-16t\omega^4)\cos(2\omega t)+(4t\omega\delta^3-6\omega\delta^2+8\omega^3+16t\delta\omega^3)\sin(2\omega t)\right)}{(\delta^2+4\omega^2)^2}\right) \quad (16)$$

Substituting these equation (16) into equation (15) and rearranging gives

$$v_2(t) = \frac{e^{-\frac{\kappa}{m}t} f_0}{\beta^2 m}\left(\frac{t^2 e^{\delta t}}{2\delta} + \frac{2\omega t^2 e^{\delta t}\sin(2\omega t) + \delta t^2 e^{\delta t}\cos(2\omega t)}{2(\delta^2+4\omega^2)} - \frac{e^{\delta t}(t\delta-1)}{\delta^3}\right) + C_2 e^{-\frac{\kappa}{m}t}$$
$$-\frac{e^{-\frac{\kappa}{m}t} f_0}{\beta^2 m}\left(\frac{e^{\delta t}\left((t\delta^4-\delta^3+12\delta\omega^2-16t\omega^4)\cos(2\omega t)+(4t\omega\delta^3-6\omega\delta^2+8\omega^3+16t\delta\omega^3)\sin(2\omega t)\right)}{(\delta^2+4\omega^2)^3}\right) \quad (17)$$

Assume that the starting point is the origin and the initial conditions at t=0 and initial velocity is zero. Using these initial conditions, the solution of equation (15) as

$$C_2 = \frac{f_0}{m\beta^2}\left(\frac{12\delta\omega^2-\delta^3}{(\delta^2+4\omega^2)^3} - \frac{1}{\delta^3}\right) \quad (18)$$

The finally, we can write the velocity time-dependent for the applied force time-dependent Cosine oscillation model2 as

$$v_2(t) = \frac{e^{-\frac{\kappa}{m}t} f_0}{\beta^2 m}\left(\frac{t^2 e^{\delta t}}{2\delta} + \frac{2\omega t^2 e^{\delta t}\sin(2\omega t) + \delta t^2 e^{\delta t}\cos(2\omega t)}{2(\delta^2+4\omega^2)} - \frac{e^{\delta t}(t\delta-1)}{\delta^3}\right) + \frac{e^{-\frac{\kappa}{m}t} f_0}{m\beta^2}\left(\frac{12\delta\omega^2-\delta^3}{(\delta^2+4\omega^2)^3} - \frac{1}{\delta^3}\right)$$
$$-\frac{e^{-\frac{\kappa}{m}t} f_0}{\beta^2 m}\left(\frac{e^{\delta t}\left((t\delta^4-\delta^3+12\delta\omega^2-16t\omega^4)\cos(2\omega t)+(4t\omega\delta^3-6\omega\delta^2+8\omega^3+16t\delta\omega^3)\sin(2\omega t)\right)}{(\delta^2+4\omega^2)^3}\right) \quad (19)$$

**4. Numerical and Results**

4.1 Velocity

In this section, we going to show the result of comparison between velocity obtained from linear modeling the velocity time-dependent via the applied force time-dependent Cosine oscillation model 1 and model 2 and the data from the experiment of K.Mackkala for Usain Bolt at Beijing Olympic Games of 2008, World Championship-Berlin 2009, London Olympic Games of 2012 and we going to show the comparison the value of correlation coefficient between our linear modeling the velocity time-dependent via the applied force time-dependent Cosine oscillation formula model 1 & model 2 and Aunchana. et al. [11] formula model 1 and model 2 in the research.

| Time | Velocity experiment[7] | Velocity Model1 | Velocity Model2 | %Difference Velocity And Velocity Model1 | %Difference Velocity And Velocity Model2 |
|---|---|---|---|---|---|
| 1.85 | 5.40 | 5.60 | 5.44 | 3.636 | 0.738 |
| 2.87 | 9.80 | 9.73 | 9.70 | 0.716 | 1.025 |
| 3.78 | 10.99 | 10.62 | 11.01 | 3.424 | 0.181 |
| 4.65 | 11.49 | 11.85 | 11.56 | 3.084 | 0.607 |
| 5.50 | 11.76 | 11.88 | 12.02 | 1.015 | 2.186 |
| 6.32 | 12.19 | 12.18 | 12.11 | 0.082 | 0.658 |
| 7.14 | 12.19 | 12.14 | 12.11 | 0.411 | 0.658 |
| 7.96 | 12.19 | 12.12 | 12.10 | 0.575 | 0.741 |
| 8.79 | 12.05 | 12.02 | 12.07 | 0.165 | 0.165 |
| 9.69 | 12.11 | 11.98 | 12.02 | 7.535 | 7.868 |
| Correlation Coefficient Model1 | | 0.987214 | Correlation Coefficient Model2 | | 0.989398 |

Table 1.1 Representation time and velocity parameter of running for Usain Bolt in the 100 metres sprint: Beijing 2008

The velocity of linear modeling the velocity time-dependent via the applied force time-dependent Cosine oscillation model 1 has more deviation of velocity than a linear modeling the velocity time-dependent via the applied force time-dependent Cosine oscillation model 2. This is consistent with Correlation Coefficient of Model 1 = 0.987214 less accurate than a Correlation Coefficient of Model 2 = 0.989398 to see table 1.2.

| Correlation Coefficient Model1 | | Correlation Coefficient Model2 | |
|---|---|---|---|
| present | 0.987214 | present | 0.989398 |
| Aunchana. et al. [11] | 0.980509 | Aunchana. et al. [11] | 0.984389 |

Table 1.2 Representation comparison of correlation coefficient between our linear modeling the velocity time-dependent model 1 & 2 and the paper research of Aunchana. et al of running for Usain Bolt in the 100 metres sprint: Beijing 2008

This is consistent with correlation coefficient of the linear modeling the velocity time-dependent model 1=0.987214 and model 2=0.989398 but Aunchana et.al. [11] mathematical and physics model 1 and 2 have a correlation coefficient of the mathematical and physics model 1 = 0.980509 and 2 = 0.984389

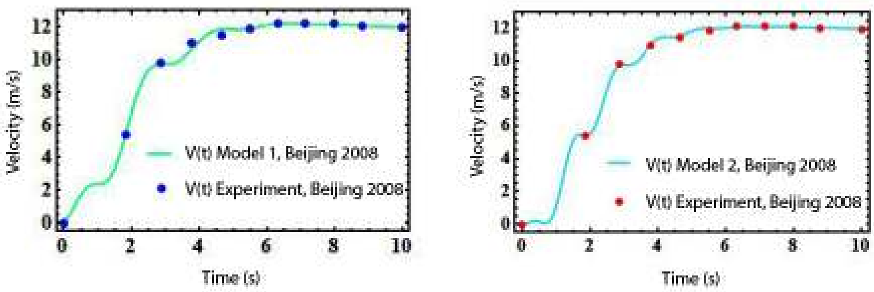


Figure 1 Comparison of the velocity-time got from the experimental data and linear modeling the velocity time-dependent via the applied force time-dependent Cosine oscillation model 1 and linear modeling the velocity time-dependent via the applied force time-dependent Cosine oscillation model 2 for Usain Bolt in the 100 m sprint at the Beijing Olympic games 2008.

From figure 1 and table 1.1, the quantity of power vitality ( $f_0$=2150.3) and sprint endurance ( $\beta$=0.9534) and angular arm swing frequency( $\omega$=1.5838) of linear modeling the velocity time-dependent via the applied force time-dependent Cosine oscillation model 1 lesser than the applied force of linear modeling the velocity time-dependent via the applied force time-dependent Cosine oscillation model 2. This can refer to anaerobic respiration of muscle cells. During athletes sprint. In circumstance of their body is lack of oxygen. Glucose in muscle cells become to lactic acid directly. although this process get only 2 ATP, Lactic acid can move out of muscle cells to liver and turn back to glucose which their body brought back to use

| Time | Velocity experiment[7] | Velocity Model1 | Velocity Model2 | %Difference Velocity And Velocity Model1 | %Difference Velocity And Velocity Model2 |
|---|---|---|---|---|---|
| 1.90 | 5.26 | 5.39 | 5.29 | 2.441 | 0.568 |
| 2.88 | 10.20 | 10.22 | 10.20 | 0.195 | 0.000 |
| 3.80 | 10.87 | 10.60 | 10.80 | 2.515 | 1.327 |
| 4.63 | 12.05 | 11.97 | 12.02 | 0.666 | 0.568 |
| 5.46 | 11.90 | 12.13 | 12.07 | 1.914 | 3.222 |
| 6.29 | 12.19 | 12.22 | 12.16 | 0.245 | 0.568 |
| 7.11 | 12.19 | 12.30 | 12.19 | 0.898 | 0.000 |
| 7.92 | 12.34 | 12.19 | 12.15 | 1.222 | 3.601 |
| 8.75 | 12.05 | 12.11 | 12.12 | 0.496 | 1.327 |
| 9.58 | 12.05 | 11.99 | 12.08 | 0.499 | 0.568 |
| Correlation Coefficient Model1 | | 0.99778 | Correlation Coefficient Model2 | | 0.999078 |

Table 2.1 Representation time and velocity parameter of running for Usain Bolt in the 100 metres sprint: World Championship-Berlin 2009

The velocity of linear modeling the velocity time-dependent via the applied force time-dependent Cosine oscillation model 1 has more deviation of velocity than a linear modeling the velocity time-dependent via the applied force time-dependent Cosine oscillation model 2. This is consistent with correlation coefficient of Model 1 = 0.99778 less accurate than a Correlation Coefficient of Model 2 = 0.999078 to see table 2.2

| Correlation Coefficient Model1 | | Correlation Coefficient Model2 | |
|---|---|---|---|
| present | 0.99778 | present | 0.999078 |
| Aunchana. et al. [11] | 0.990779 | Aunchana. et al. [11] | 0.991065 |

Table 2.2 Representation comparison of correlation coefficient between our linear modeling the velocity time-dependent model 1 & 2 and the paper research of Aunchana. et al of running for Usain Bolt in the 100 metres sprint: Berlin 2009

This is consistent with correlation coefficient of the linear modeling the velocity time-dependent model 1 = 0.99778 and model 2 = 0.999078 but Aunchana. Ate. [11] mathematical and physics model 1 and 2 have a Correlation Coefficient of The mathematical and physics model 1 = 0.990779 and 2 = 0.991065 to see table 2.2.

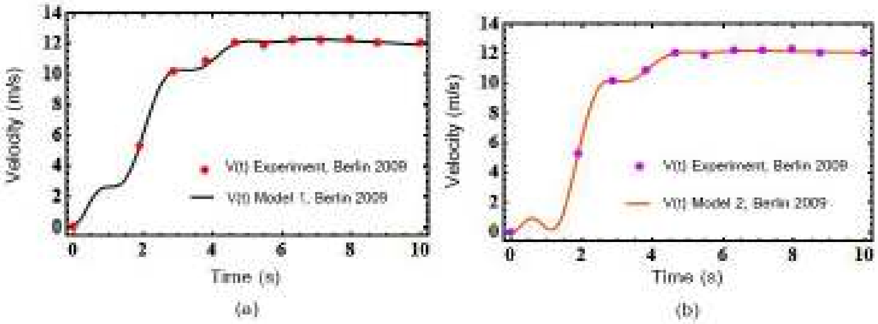


Figure 2, Comparison of the velocity-time got from the experimental data and linear modeling the velocity time-dependent via the applied force time-dependent Cosine oscillation model 1 (a) and linear modeling the velocity time-dependent via the applied force time-dependent Cosine oscillation model 2 (b) for Usain Bolt in the 100 m sprint at the Berlin world championships in Athletics 2009.

From figure 2 and table 2.1, the quantity of angular arm swing frequency ( $\omega$=1.4660) of linear modeling the velocity time-dependent via the applied force time-dependent Cosine oscillation model 1 greater than the applied force of linear modeling the velocity time-dependent via the applied force time-dependent Cosine oscillation model 2 but the quantity of power vitality ( $f_0$=8359.7) and sprint endurance ( $\beta$=1.4652) lesser than model 2

| Time | Velocity Experiment[7] | Velocity Model1 | Velocity Model2 | %Difference Velocity And Velocity Model1 | %Difference Velocity And Velocity Model2 |
|---|---|---|---|---|---|
| 1.91 | 5.23 | 5.34 | 5.37 | 2.081 | 2.641 |
| 2.92 | 9.90 | 9.99 | 9.67 | 0.904 | 2.350 |
| 3.84 | 10.87 | 10.46 | 10.95 | 3.844 | 0.733 |
| 4.70 | 11.63 | 11.86 | 11.59 | 1.958 | 0.344 |
| 5.54 | 11.90 | 11.98 | 12.13 | 0.670 | 1.914 |
| 6.36 | 12.19 | 12.16 | 12.19 | 0.246 | 0 |
| 7.17 | 12.34 | 12.27 | 12.22 | 0.568 | 0.977 |
| 7.98 | 12.34 | 12.21 | 12.22 | 1.059 | 0.977 |
| 8.80 | 12.19 | 12.20 | 12.17 | 0.082 | 0.162 |
| 9.63 | 12.05 | 12.14 | 12.13 | 0.738 | 0.651 |
| Correlation Coefficient Model1 | | 0.996813 | Correlation Coefficient Model2 | | 0.998105 |

Table 3.1 Representation time and velocity parameter of running for Usain Bolt in the 100 metres sprint: London 2012

The velocity of linear modeling the velocity time-dependent via the applied force time-dependent Cosine oscillation model 1 has more deviation of velocity than a linear modeling the velocity time-dependent via the applied force time-dependent Cosine oscillation model 2. This is consistent with Correlation Coefficient of Model 1 = 0.996813 less accurate than a Correlation Coefficient of Model 2 = 0.998105 to see table 3.2.

| Correlation Coefficient Model1 | | Correlation Coefficient Model2 | |
|---|---|---|---|
| present | 0.996813 | present | 0.998105 |
| Aunchana. et al. [11] | 0.993331 | Aunchana. et al. [11] | 0.995046 |

Table 3.2 Representation comparison of correlation coefficient between our linear modeling the velocity time-dependent model 1 & 2 and the paper research of Aunchana. et al of running for Usain Bolt in the 100 metres

sprint: Berlin 2009. This is consistent with Correlation Coefficient of The linear modeling the velocity time-dependent model 1=0.996813 and model 2=0.998105 but Aunchana. Ate. [11] mathematical and physics model 1 and 2 have a Correlation Coefficient of The mathematical and physics model 1 = 0.993331 and 2 = 0.995046

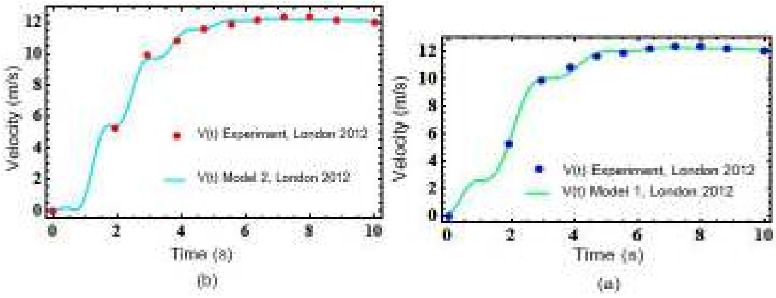


Figure 3 Comparison of the velocity-time got from the experimental data and linear modeling the velocity time-dependent via the applied force time-dependent Cosine oscillation model 1 and linear modeling the velocity time-dependent via the applied force time-dependent Cosine oscillation model 2 for Usain Bolt in the 100 m sprint at the London Olympic games 2012.

From figure 3 and table 3.1, the quantity of power vitality ($f_0$=2080.0) and sprint endurance ($\beta$=0.9308) and angular arm swing frequency ($\omega$=1.4707) of linear modeling the velocity time-dependent via the applied force time-dependent Cosine oscillation model 1 lesser than the applied force of linear modeling the velocity time-dependent via the applied force time-dependent Cosine oscillation model 2($f_0$=4483.9, $\beta$=1.3046, $\omega$=2.4266). Next, we will use the data obtained from our equation to shown the power of the sprinter and kinetic energy in a form of graph and analyze the result [8,9,10].

## 5. Conclusion

In conclusion. Correlation Coefficient value obtained from our linear modeling the velocity time-dependent via the applied force time-dependent Cosine oscillation model 1 and model 2 has value closer to 1 than Aunchana C. et al.[11] mathematical and physics model 1 and 2 (see Table 1.2, 2.2 and 3.2). In some models the air resistance don't affect the sprinter according to the value of air resistance obtained from the equation closer to 0 (see model 2 in figure 1, 2 and 3).

**Conflict of Interests**

The authors declare that there is no conflict of interests regarding the publication of this paper.

**Acknowledgements**

We acknowledge Wittayanukulnaree School and The Institute for the Promotion of Teaching Science and Technology (IPST) and Physics Division, Faculty of Science and Technology, Phetchabun Rajabhat University, Thailand, for partial support of computer.

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