A Model for Analysis of Work Done by a Special Force

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https://emfps.blogspot.com/2018/02/a-model-for-analysis-of-work-done-by.html

This model is an example as application one of theorems mentioned in article of "The Change Depends on the Direction of the Motion: The Symmetric Group Action (2)" posted on link:

http://www.emfps.blogspot.com/2017/08/the-change-depends-on-direction-of_9.html?m=1

Work Done by Force

When we are speaking about the work done by a force, we have usually two options:

1. The work done on a particle by a constant force in magnitude and direction which is calculated by below equation:

$$W = \overrightarrow{F} \cdot \Delta r \cdot Cos\,\theta$$

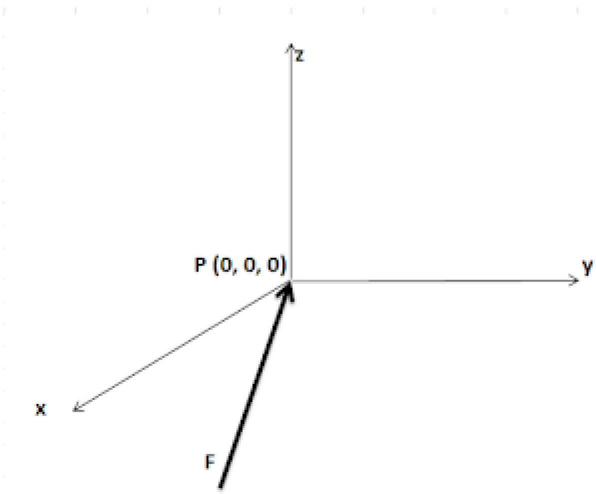
2. The work done on a particle by a varying force in magnitude and direction in which we should use the line integral to calculate it as follows:

$$\vec{F} = M(x,y,z)i + N(x,y,z)j + P(x,y,z)k$$

$$W = \int \vec{F} \cdot \vec{r} = \int M(x,y,z)\,dx + N(x,y,z)\,dy + P(x,y,z)\,dz$$

But, in this article, I am willing to introduce you a special force which has the constant magnitude but varying in direction. In this case, I have made a model that it is able to show us the location of the particle after being displaced by this special force.

Suppose a particle P (0, 0, 0) just like below figure being displaced by a force F:



Theorem: The force with below vector has the constant magnitude equal to <u>1.22474487139159</u> but varying in direction:

$$\vec{F} = Sin\,\varphi\, i + Sin\,(60 - \varphi)j - Sin\,(60 + \varphi)k$$

$$\|\vec{F}\| = 1.22474487139159$$

(Where φ is degree)

In this case, we can still use option (1) and below equation to calculate the work done:

$$W = \vec{F} \cdot \Delta r \cdot Cos\,\theta$$

Below figure shows the components of this model:

	A	B	C	D	E	F	G	H	I	J
1	Go	Back		Inputs			Outputs			
2			ϕ	155			i	j	k	||F||
3			r	77		Force vector	0.422618	-0.99619	0.573576	1.224745
4						Direction of Force	0.345066	-0.81339	0.468323	1
5						Work Done	41.8815			
6							i	j	k	||r||
7						Location of the Particle	-5.37043	-0.09374	76.81243	77
8						Direction of the Particle	-0.06975	-0.00122	0.997564	1
9										

Let me explain you about the components of above model as follows:

1. In left side on cells C2:D3, we have inputs including the angle ϕ (degree) of force vector and amount of displacement of particle “P” which is “r”.

2. In right side on cells F3:J8, we have outputs including:

2-1) on cells G3:I3, a special force vector can be calculated by using above theorem.

2-2) on cells G4:I4, the direction of special force can be obtained by using below formula:

$$Direction\ \vec{F} = \frac{Sin\ \varphi\ i}{\|\vec{F}\|} + \frac{Sin\ (60 - \varphi) j}{\|\vec{F}\|} - \frac{Sin\ (60 + \varphi) k}{\|\vec{F}\|}$$

The magnitude of this force is the constant and equal to 1.22474487139159.

2-3) on cell G5, we have the work done which is calculated by below formulas:

$$\vec{r} = xi + yj + zk$$

$$\vec{F} = Sin\,\varphi\, i + Sin\,(60 - \varphi)j - Sin\,(60 + \varphi)k$$

$$W = \vec{F} \times \vec{r}$$

$$W = xSin\,\varphi + ySin\,(60 - \varphi) - z\,Sin\,(60 + \varphi)$$

2-4) on cells G7:I7, we have the location particle P (x, y, z) which is derived by this model.

2-5) on cells G8:I8, the direction of motion particle P can be calculated by using below formula:

$$Direction\ P(x, y, z) = \frac{xi}{||r||} + \frac{yj}{||r||} + \frac{zk}{||r||}$$

2-6) The change of direction particle P will be done by click on cell A1 and also this change will again go back by click on cell B1 (Go & Back).