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The Point of Speed and Acceleration

Oybek Azatboyevich Maniyozov [1]

Abstract: As you know, the kinematics of the main chair point (solid) of action of law, the study consists of. You get the system to any body in relations to the law of motion if it is given, the point is the member of the movement: trajectory, and can determine the speed of it.

There fore hhow hard land of the collection is solid at the point from which you can look. For the same reason , to feel the movement of body and movement study to study the point comes.

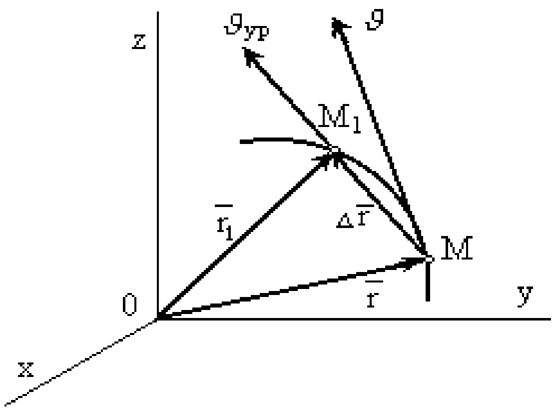
key word: trajectory, speed, acceleration, vector, radius–vector.

Introduction. *When it is given by the speed of the motion vector in the point metho.*

Right rectangular coordinate system, point to relations mov moment you've m. During the time t of the point $\bar{r}$ on the radius–vector and thus identifying with the point m at time t_1 during your M_1 position they radius – vector of $\bar{r}_1$ the (3-picture).

It is without a point in $\Delta t = t_1 - t$ time in the range $\overline{MM}_1 = \Delta\bar{r}$ to move. Om I_1 , we will write that here.

$$\overline{MM}_1 = \bar{r}_1 - \bar{r} = \Delta\bar{r}$$



the vector $\Delta\bar{r}$ option, the same to happen Δt - to-time ratio in the range of the speed vector of the point of time is called the central far.

$$\bar{\vartheta}_{yp} = \frac{\Delta\bar{r}}{\Delta t} \qquad (1)$$

Central far the speed vector $\bar{\vartheta}_{YP}$ $\Delta\bar{r} = \overline{MM}_1$ of vector to either the zero - to. Δt time range how small I get, the point of the action, the character $\bar{\vartheta}_{YP}$ size is so clear to. The point is that the movement cert characteristics to be ab handle to a given point, the speed concept is introduced.

Point the central far the speed vector Δt to zero were committed when the limit point is given speed (instantaneous speed) of a vector is called and $\bar{\vartheta}$ by determined:

$$\bar{\vartheta} = \lim_{\Delta t \to 0}\left(\bar{\vartheta}_{yp}\right) = \lim_{\Delta t \to 0}\frac{\Delta\bar{r}}{\Delta t}$$

or

$$\bar{\vartheta} = \frac{d\bar{r}}{dt} \qquad (8)$$

[1] TATU Fergana branch assistant

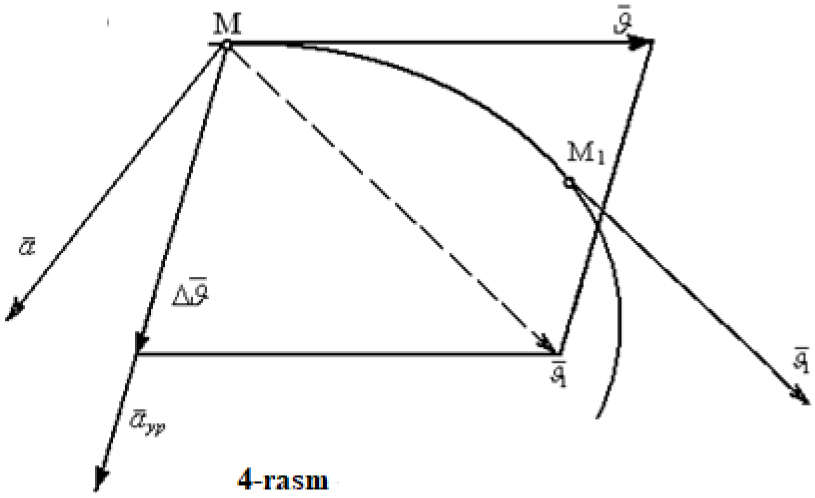
Therefore, the point of the need of its radius vector – vector obtained equal to safely push on the time of the first order.

The measurement of the speed of the unit vector $[\vartheta] = \frac{[uzunlik]}{[vaqt]} = \frac{L}{T}$, of the speed with lovely main $\frac{m}{s}$ or $\frac{km}{soat}$ s is measured.

Metho motion vector will point in the given acceleration.

The point in any direction and the speed of the time interval that the module would change the character of the great acceleration is called.

How is the time t time point m is the position in the speed $\bar{\vartheta}$, the time t_1 during your point M_1 to the need comes with the condition $\bar{\vartheta}_1$, which is (4-picture). $\Delta t = t_1 - t$ time range point need $\Delta\bar{\vartheta} = \bar{\vartheta}_1 - \vartheta$ not get. $\Delta\bar{\vartheta}$ need to determine the way you $\bar{\vartheta}_1$ M_1 m vector parallel to itself at the point of move speed, $\bar{\vartheta}$ and $\bar{\vartheta}_1$ the speed vector on the basi parallelogram , we will build.



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The second side Parallelogram $\Delta\bar{\vartheta}$ need of do not increase to become is. Needless to record your, $\Delta\bar{\vartheta}$ always need the vector trajectory ala his heavy coast side looking at to be made. $\Delta\bar{\vartheta}$ need do not increase the computer's Δ point average of the ratio of t to acceleration is called:

$$\bar{a}_{yp} = \frac{\Delta\bar{\vartheta}}{\Delta t} \qquad (9)$$

$\bar{a}_{yp}$ vector direction $\Delta\bar{\vartheta}$ is a direction vector of kindigi. The point is that the average acceleration vector $\bar{a}_{YP}$ select Δt to zero were committed in the time given point is the limit when acceleration vector is called:

$$\bar{a} = \lim_{\Delta t \to 0} \frac{\Delta\bar{\vartheta}}{\Delta t} \quad \text{or} \quad \bar{a} = \frac{d\bar{\vartheta}}{dt} = \frac{d^2\bar{r}}{dt^2} \qquad (10)$$

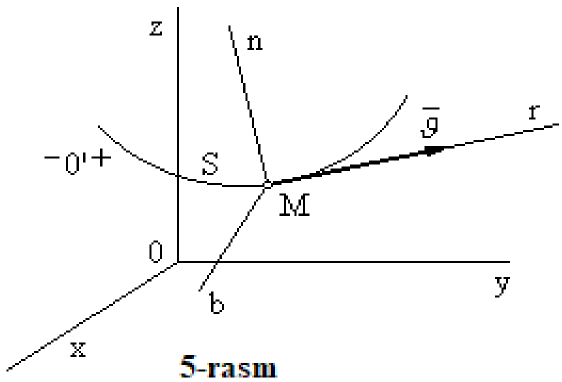
Therefore, in the given time to the point of acceleration point vector vector obtained to the first order need to push or lovely on the time of the radius–vector obtained from the second order on time and safely to push equal.

acceleration the measurement unit $\frac{L}{T^2}$ or $\frac{uzunlik}{(vaqt)^2}$, acceleration basically $\frac{m}{s^2}$ atis measured.

Mov a point along a straight line to be on its the moment we've acceleration vector directed along the same straight line to have been her. If the trajectory is the curve of the line from to, acceleration vector trajectory is heavy along the coast looking at her side.

The action is given by the point when it is a natural way of speed .

The point is the movement that *s=f(t)* and its speed when it is given form in a natural way acceleration will determine.



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We are in the same time up to the point $\bar{\vartheta}$ speed, $\bar{a}$ acceleration vector module and fixed O*xyz* coordinate system axis projections by, we would determine that. Action natural metho point when given $\bar{\vartheta}$ speed and $\bar{a}$ acceleration vector module and fixed O*xyz* coordinates into the system, but the point is together with your mov $M\tau nb$ coordinate system axis projections is determined. $M\tau$ arrow point trajectory to don't try to make are transferred. Mn the axis $M\tau$ along the axis perpendicular to the coast, depending on the heavy side are transferred to her trajectory. This rasta - head is called the normal axis. To the axis perpendicular to both Mb the axis is transferred to. This rasta binormal called the arrow (5-picture).

The point of $\bar{\vartheta}$ the vector to the speed trajectory don't try was directed across. Its $M\tau$ axis projection ϑ_τ $\vartheta_\tau = \vartheta$ or $\vartheta_\tau =- \vartheta$ you can. Then Also ϑ_τ to ϑ we will sign with.

ϑ let's see what we will take to determine value. During the time t of the point trajectory of m at the point $t_1 + \Delta t$ M, then the time from₁ comes to a point. Δt time range point the curve is the line knew trajectory across $\Delta s = \overset{\cup}{MM_1}$ to move (5-picture). Δs - the unit of the coordinates of gain. Point of central peru , the speed of $\vartheta_{yp} = \frac{\Delta S}{\Delta t}$ the formula using the determined

Point given in it need the central far from the rate Δt select just yearning take the limit to equal

$$\vartheta = \lim_{\Delta t \to 0} \frac{\Delta s}{\Delta t} = \frac{ds}{dt}$$

or

$$\vartheta = \frac{ds}{dt} = \dot{s} \qquad (21)$$

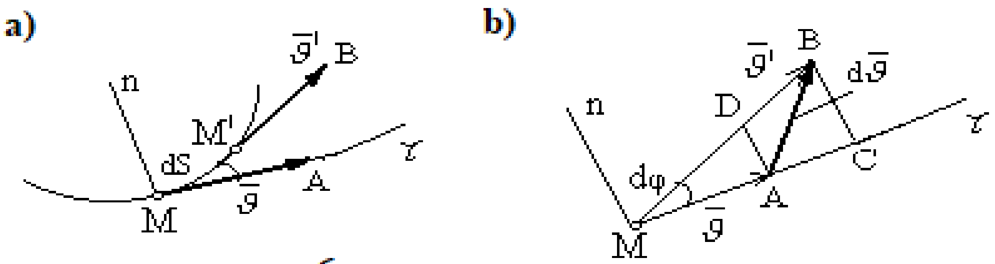
The speed that is the distance from the point (coordinates from network line is the curve) is equal to time taken up first.

Point don't try and normal acceleration of.

In Point $M\tau n$ after point for the subscriber mov planet acceleration vector Mb axis projection $(a_b = 0)$ is equal to zero. Because Mb - this planet was directed perpendicular axis. Point acceleration $M\tau$ and Mn the arrow in projections you will determine that. To do this (10) equality $M\tau$ and Mn the arrow to we project:

$$a_\tau = \frac{(d\vartheta)\tau}{dt}, \qquad a_n = \frac{(d\vartheta)n}{dt} \qquad (22)$$

The point of m and M[1] case velocity difference $d\overline{\vartheta}$ vector with the understanding the character of (6 - a), it is without



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$$d\overline{\vartheta} = \overline{\vartheta}^1 - \overline{\vartheta}.\ \overline{\vartheta} = \overline{MA} \text{ and } \overline{\vartheta}^1 = \overline{MB}$$

$\overline{\vartheta} = \overline{MA}$ va $\overline{\vartheta}' = \overline{MB}$ vector of the total to present where we will move to the point M, (6-picture,b) as a result $d\overline{\vartheta} = \overline{A}B$ will be. $d\varphi$ the mean if it is too small, the ABCD figure can be look as on the rectangular. Without it:

$$(d\vartheta)_\tau = AC = DB = MB - MA = \vartheta^1 - \vartheta = d\vartheta$$

To the arc watar limit obtained from the ratio to be equal for his ala ED, MA radius of the physics of the fundamental force of the arc heating without

$$(d\vartheta)_n = AD = MAd\varphi = \vartheta d\varphi$$

$(d\vartheta)_\tau$ and $(d\vartheta)_n$ the world of the value of (22) will yield put to the following:

$$a_\tau = \frac{d\vartheta}{dt}, \quad a_n = \vartheta\frac{d\varphi}{dt}, \qquad (23)$$

(23) of the second equality of the right side of stir and change:

$$\vartheta\frac{d\varphi}{dt} = \vartheta\frac{d\varphi}{ds}\frac{ds}{dt}$$

this here: $\frac{d\varphi}{ds} = k$ - curvature curved line coefficient. It has the following form, we will sign:

$$k = \frac{1}{\rho} \qquad (24)$$

this here: ρ - radius of curvature of the curved line.

(21) and (24) we can consider (23) in the second equality following from the sight of not just get:

$$a_n = \vartheta\frac{d\varphi}{ds}\frac{ds}{dt} = \vartheta\cdot\frac{1}{\rho}\cdot\vartheta = \frac{\vartheta^2}{\rho}$$

As a result, the following possible you will be

$$a_\tau = \frac{d\vartheta}{dt} = \frac{d^2s}{dt^2},. \qquad a_n = \frac{\vartheta^2}{\rho}, \qquad a_в = 0 \qquad (25)$$

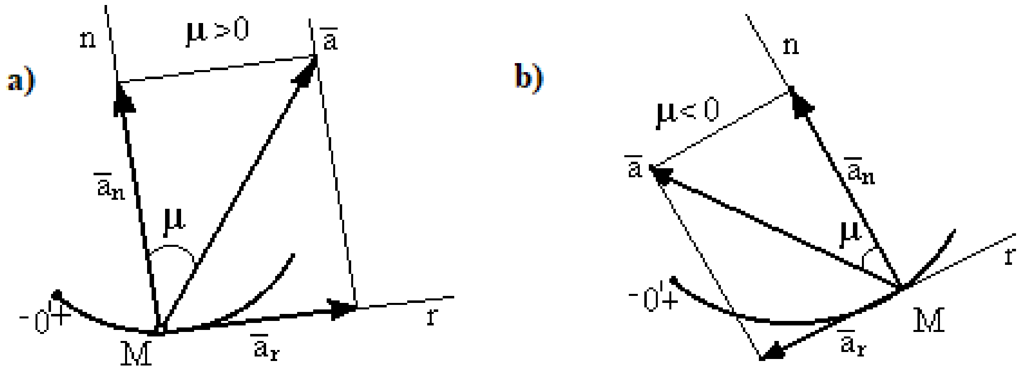
a_τ – point don't try (tangentially) of acceleration,

a_n - the point is that the normal acceleration.

In doing so, the point of acceleration don't try in projection need, updated and expanded , the value obtained from the first arc to push the coordinates of the point on the time or on the time taken equal to a second push, the point of acceleration normal home projection, the point is you need of the square the trajectory of a given point is equal the ratio of the radius of curvature.

Point acceleration vector $\bar{a}$, don't try acceleration $\bar{a}_\tau$ and normal acceleration $\bar{a}_n$ s equal to the geometric sum (7-picture).

$$\bar{a} = \bar{a}_\tau + \bar{a}_n$$



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acceleration module and direction

$$a = \sqrt{a_\tau^2 + a_n^2} = \sqrt{\left(\frac{d\vartheta}{dt}\right)^2 + \left(\frac{\vartheta^2}{\rho}\right)^2}$$

$$tg\mu = \frac{a_\tau}{a_n} \qquad (26)$$

the formula is determined using.

Bdog here - $\mu\rangle$ o be $-\frac{\pi}{2}\langle\mu\langle\frac{\pi}{2}$ willhe without $\bar{a}$ acceleration vector of m and$_n$ from a normal M $_\tau$ on the arrow of the deviation from the side of the (7-a picture,a), $\mu < 0$ b- die, the reverse side of the deviation from the (7-picture, b).

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