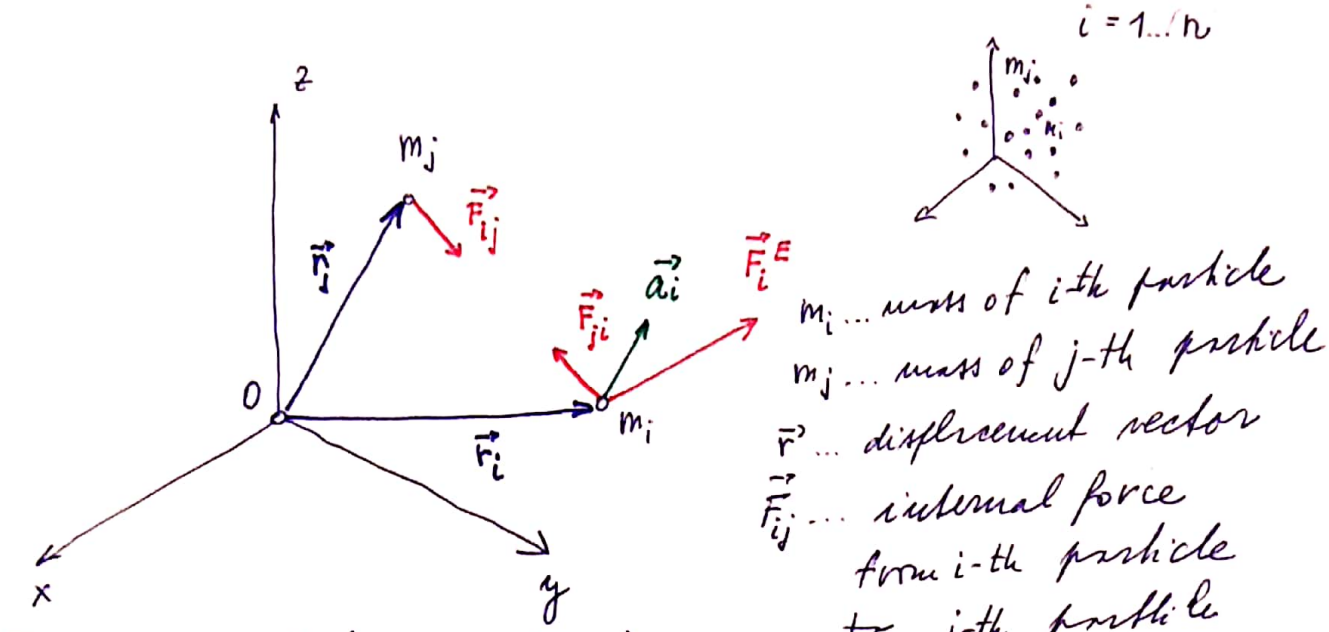
DYNAMICS OF SYSTEM OF PARTICLES



$\vec{F}_i^E$ ... external force (resulting) acting to particle i

m_i ... mass of i-th particle

m_j ... mass of j-th particle

$\vec{r}$ ... displacement vector

$\vec{F}_{ij}$ ... internal force from i-th particle to j-th particle

$\vec{F}_{ji}$ ... force from j to i

$$\sum_{(i)} \vec{F}_i^E = \vec{F}^E$$ ... sum of all external forces acting to system of particles

$$\sum_{(i)} (\vec{r}_i \times \vec{F}_i^E) = \vec{M}^E$$ ... resulting moment of external forces acting to syst. of particles

For internal forces we can write: $\vec{F}_{ji} = -\vec{F}_{ij}$

$$\sum_{(i)} \left(\sum_{j} \vec{F}_{ji} \right) = \vec{\emptyset}$$ ... resulting force of internal forces $\vec{\emptyset}$

$$\sum_{(i)} \left(\vec{r}_i \times \sum_{(j)} \vec{F}_{ji} \right) = \vec{\emptyset}$$ ... resulting moment of internal forces $\vec{\emptyset}$

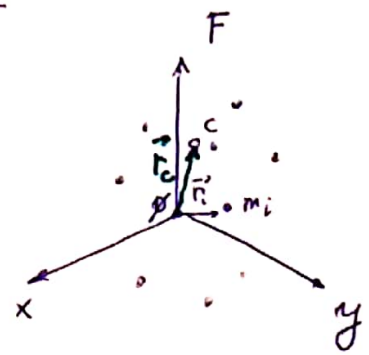
Equation of motion of i-th particle

$$m_i \vec{a}_i = \vec{F}_i^E + \sum_{(j)} \vec{F}_{ji} \qquad j = 1 \dots n$$

LAW OF MOTION OF CENTER OF MASS OF SYSTEM OF PARTICLES

$\vec{r}_i (x_i, y_i, z_i)$ .... displacement vector of i-th particle

$\vec{r}_c (x_c, y_c, z_c)$ ... displacement vector of center of mass



we know:

$$m \cdot \vec{r}_c = \sum_{(i)} (m_i \vec{r}_i) \quad / \frac{d}{dt}$$

$m = \sum_{(i)} m_i$ .... total mass of system of particles

$$m \cdot \vec{v}_c = \sum_{(i)} m_i \vec{v}_i \quad / \frac{d}{dt}$$

$\vec{v}_c$ ... velocity of center of mass

$$m \cdot \vec{a}_c = \sum_{(i)} m_i \vec{a}_i$$

$\vec{v}_c = \frac{d\vec{r}_c}{dt}$

$\vec{a}_c$ ... acceleration of center of mass $\vec{a}_c = \frac{d\vec{v}_c}{dt}$

Equation of motion of i-th particle of the system:

(i) $m_i \vec{a}_i = \vec{F}_i^E + \sum_{(j)} \vec{F}_{ji}$ $\quad / \sum_{i=1..n}$

$$\sum m_i \vec{a}_i = \underbrace{\sum_{(i)} \vec{F}_i^E}_{\vec{F}^E} + \underbrace{\sum_{(i)} \left(\sum_{(j)} \vec{F}_{ji} \right)}_{\vec{\emptyset}}$$

(1) $m_1 \cdot \vec{a}_1 = \dots$

(2) $m_2 \cdot \vec{a}_2 = \dots$

$\vdots$

(i) $m_i \vec{a}_i = \dots$

$\vdots$

(n) $m_n \cdot \vec{a}_n = \dots$

$$\sum_{(i)} m_i \vec{a}_i = \vec{F}^E$$

$$m \vec{a}_c = \vec{F}^E$$

total mass of system

acceleration of center of mass

resulting external force acting to the system of particles

1) Internal forces doesn't influence the motion of the center of mass of a system.

2) If the resulting force of external forces is ~~zero~~ the center of mass is in rest or makes a rectilinear motion with constant velocity.

$(\vec{F}^E = \vec{0})$