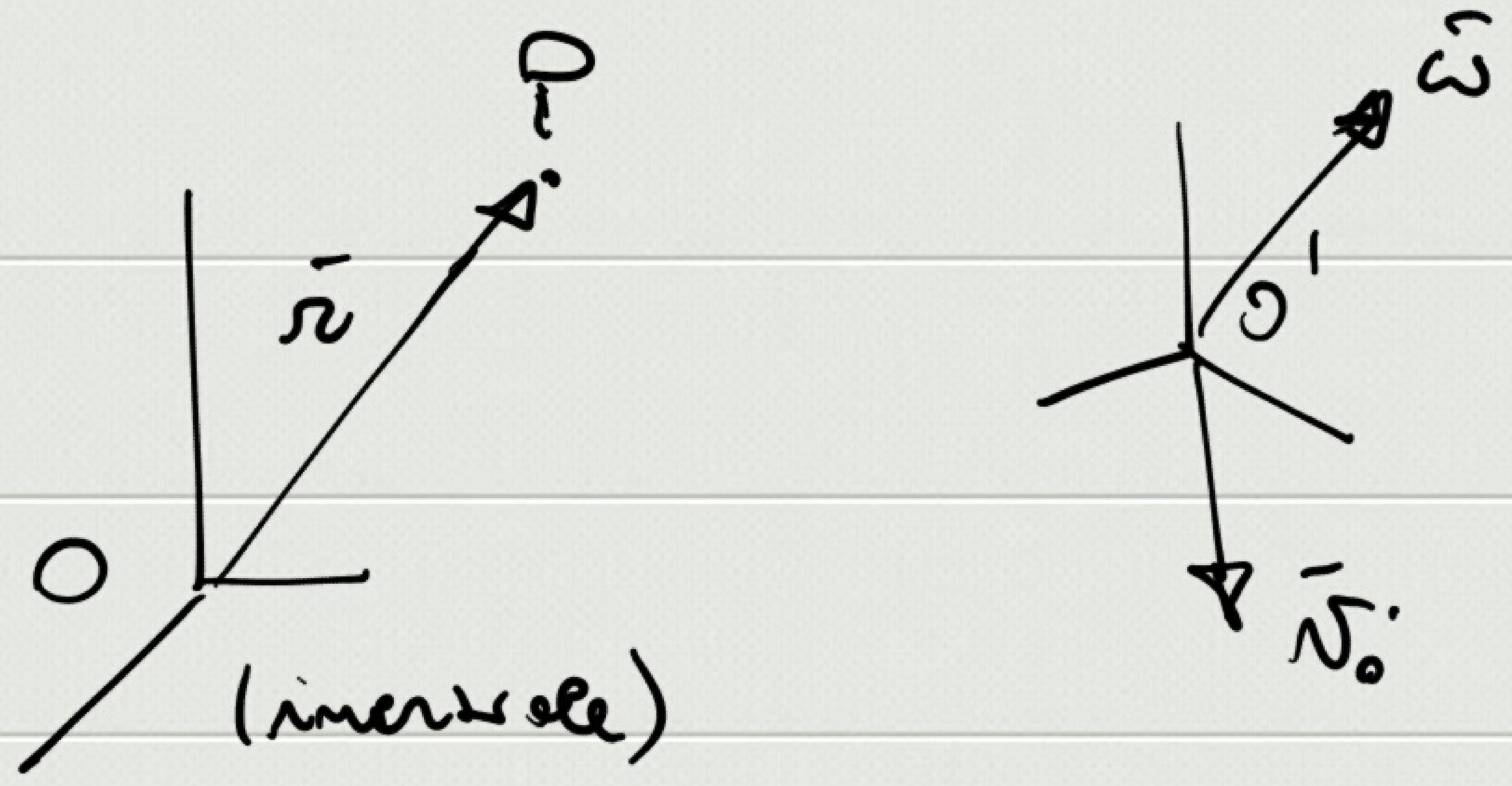
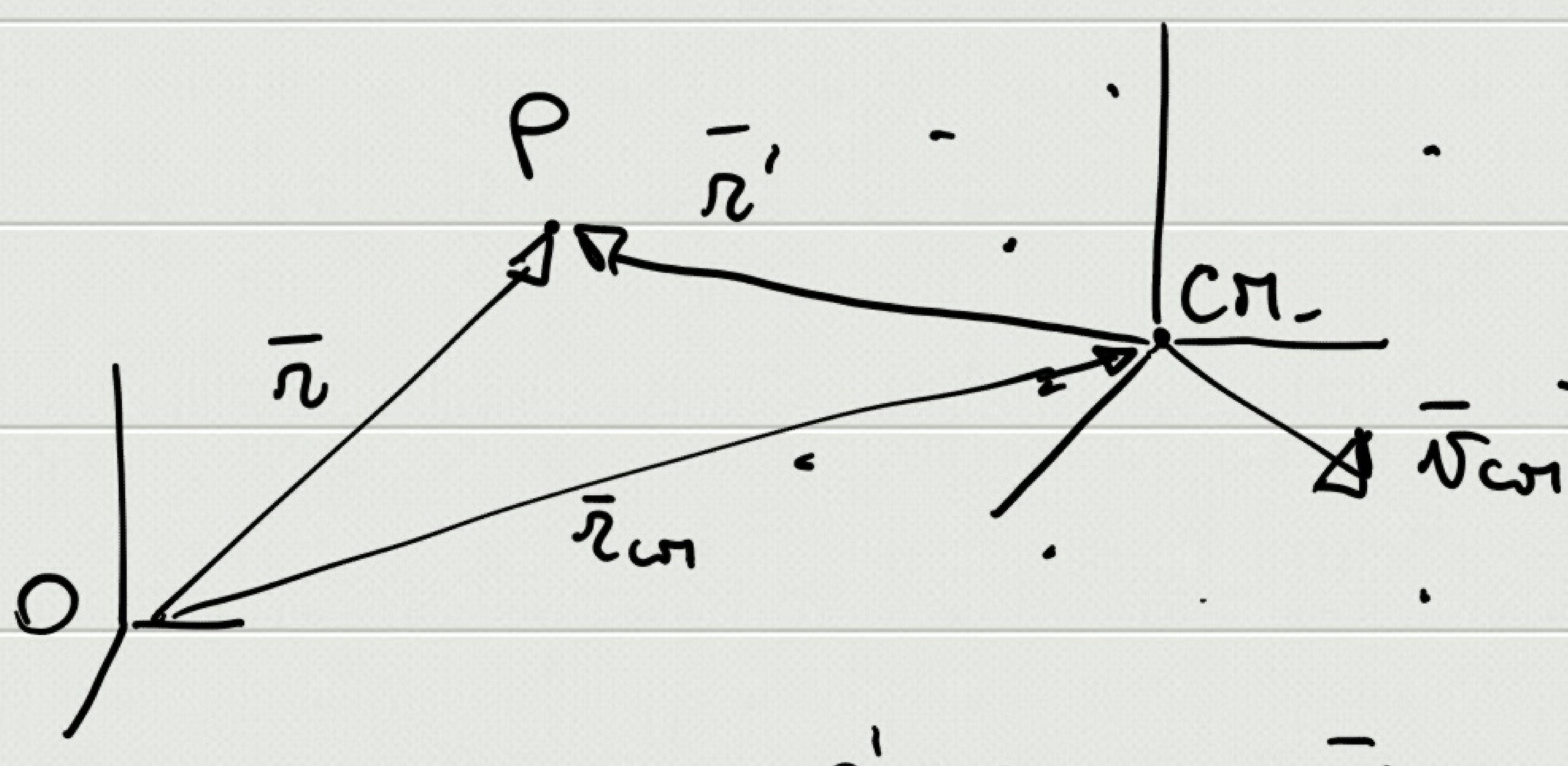



$$\bar{r} = \bar{r}' + \bar{r}_{O'}$$

$$\bar{v} = \bar{v}' + \bar{v}_{O'} + \bar{\omega} \times \bar{r}'$$

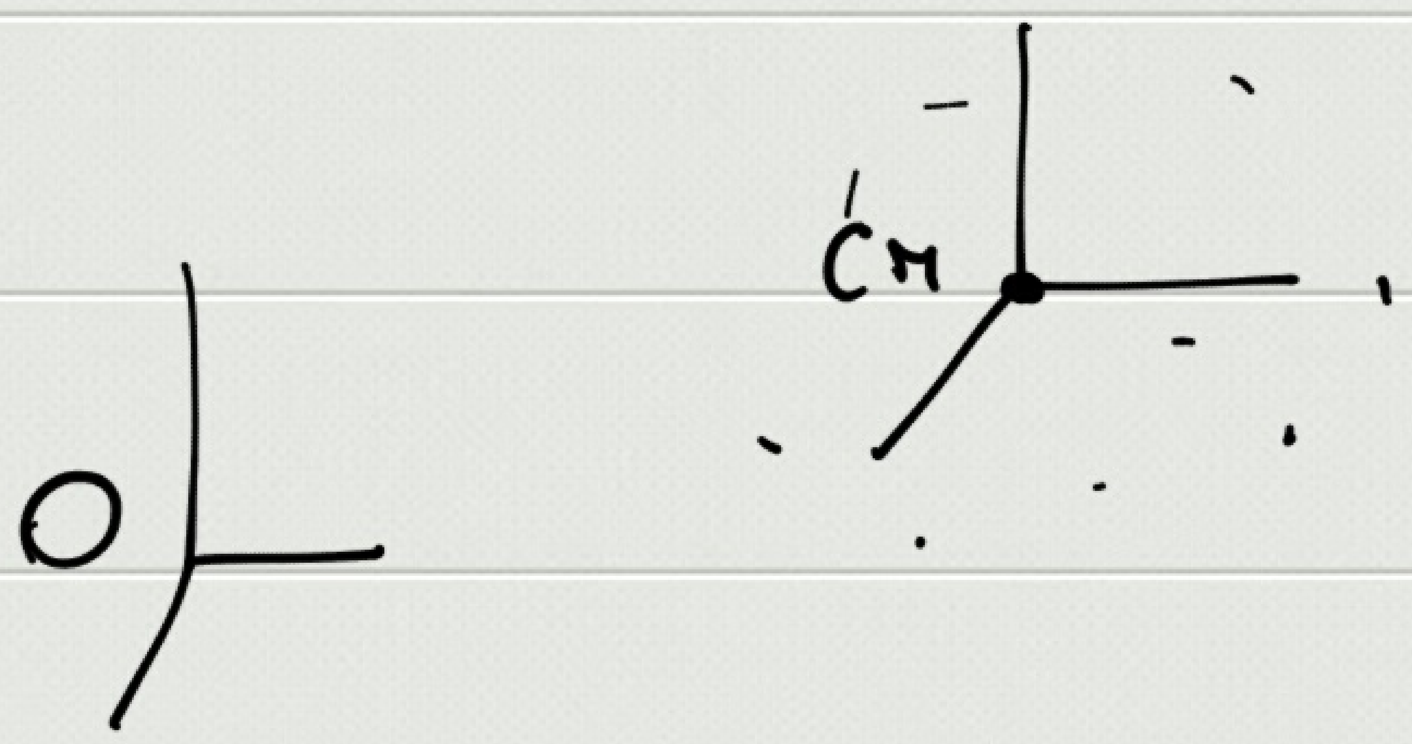
$$\bar{a} = \bar{a}' + \bar{a}_{O'} + \bar{\omega} \times (\bar{\omega} \times \bar{r}') + \frac{d\bar{\omega}}{dt} \times \bar{r}' + 2\bar{\omega} \times \bar{v}'$$




$O' \equiv CM \qquad \bar{\omega} = 0$

Sistema di riferimento del centro di massa

$$\begin{cases} \bar{r} = \bar{r}' + \bar{r}_{CM} \\ \bar{v} = \bar{v}' + \bar{v}_{CM} \\ \bar{a} = \bar{a}' + \bar{a}_{CM} \end{cases} \Rightarrow \begin{cases} \bar{r}' = \bar{r} - \bar{r}_{CM} \\ \bar{v}' = \bar{v} - \bar{v}_{CM} \\ \bar{a}' = \bar{a} - \bar{a}_{CM} \end{cases}$$




$$\left.\begin{array}{l}\bar{r}'_{CM} = 0 \\ \quad \overset{!}{=} \dfrac{\sum_i m_i \bar{r}'_i}{\sum_i m_i}\end{array}\right\} \Rightarrow \boxed{\sum_i m_i \bar{r}'_i = 0}$$

$$\left.\begin{array}{l}\bar{v}'_{CM} = 0 \\ \quad \overset{!}{=} \dfrac{\sum_i m_i \bar{v}'_i}{\sum_i m_i}\end{array}\right\} \quad \boxed{\sum_i m_i \bar{v}'_i = 0}$$

$$\bar{P}' = \sum_i \bar{p}'_i = \sum_i m_i \bar{v}'_i = 0 \Rightarrow \boxed{\bar{P}' = 0}$$

$$\bar{P}' = \sum_i m_i \bar{v}'_i = \sum_i m_i (\bar{v}_i - \bar{v}_{CM}) =$$

$$= \sum_i m_i \bar{v}_i - \sum_i m_i \bar{v}_{CM} = \bar{P} - m_{TOT} \bar{v}_{CM} = 0$$

$$\Rightarrow \bar{P} = m_{TOT} \bar{v}_{CM}$$

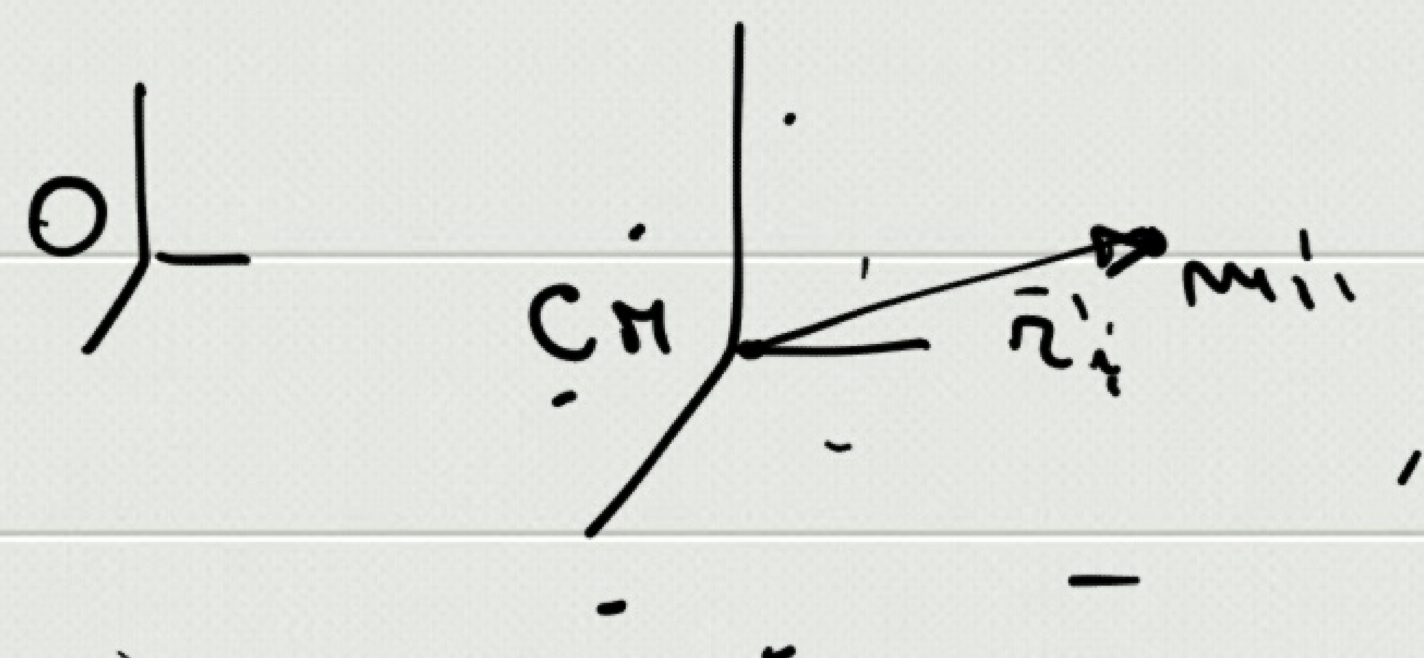
$$\left.\begin{aligned}\bar a'_{CM} &= 0 \\ &= \frac{\sum_i m_i \bar a'_i}{\sum_i m_i}\end{aligned}\right\} \Rightarrow \boxed{\sum_i m_i \bar a'_i = 0}$$

$$\bar R' = \sum_i \bar F'_i = \sum_i m_i \bar a'_i = 0 \Rightarrow \boxed{\bar R' = 0}$$

$$\bar R' = \sum_i m_i \bar a'_i = \sum_i m_i \left(\bar a_i - \bar a_{CM}\right) = \sum_i m_i \bar a_i - \sum_i m_i \bar a_{CM} =$$

$$= \sum_i \bar F_i - m_T \bar a_{CM} = 0 \Rightarrow \boxed{\bar R^E = m_T \bar a_{CM}}$$

$$\bar L_{CM} = \sum_i \bar L_{i,CM} =$$




$$= \sum_i \bar r'_i \times m_i \bar v_i =$$

$$= \sum_i \bar r'_i \times m_i \left(\bar v'_i + \bar v_{CM}\right) =$$

$$= \sum_i \bar r'_i \times m_i \bar v'_i + \sum_i \bar r'_i \times m_i \bar v_{CM} =$$

$$= \sum_i \bar L'_{CM,i} + \cancel{\underbrace{\sum_i m_i \bar r'_i}_{=0} \times \bar v_{CM}} =$$

$$= \bar L'_{CM}$$

$$\Rightarrow \boxed{\bar L_{CM} = \bar L'_{CM}}$$

$$\bar{M}^{E}_{CM} = \bar{M}'^{E}_{CM}$$

$\Rightarrow$ pol CM :
$$\frac{d\bar{L}_0}{dt} = -\bar{v}_0 \times \cancel{M_{tot}\,\bar{v}_{CM}} + \bar{M}^{E}_{0}$$

$$\Rightarrow \quad \frac{d\bar{L}_{CM}}{dt} = \bar{M}^{E}_{CM}$$

$$\Rightarrow \quad \boxed{\frac{d\bar{L}'_{CM}}{dt} = \bar{M}'^{E}_{CM}}$$