- 1. r: r(t), (x, y, z)(t), r(s).
 - $\dot{\boldsymbol{r}}$: $\dot{\boldsymbol{r}}(t)$, $(\dot{x}, \dot{y}, \dot{z})(t)$, $\boldsymbol{\tau}\dot{s}$.
 - $\ddot{\boldsymbol{r}}$: $\ddot{\boldsymbol{r}}(t)$, $(\ddot{\boldsymbol{x}}, \ddot{\boldsymbol{y}}, \ddot{\boldsymbol{z}})(t)$, $\ddot{\boldsymbol{s}}\boldsymbol{\tau} + \dot{\boldsymbol{s}}^2 k_1 \boldsymbol{n}$
- $2. \langle ? \rangle$
- 3. В криволинейных координатах

$$riangleright v = \sum_{k} \dot{q}^k e_k$$

$$ho \; oldsymbol{w} = \sum_{k} oldsymbol{\dot{q}}^{k} oldsymbol{e}_{oldsymbol{k}} + \sum_{k,i} oldsymbol{\dot{q}}^{k} oldsymbol{\dot{q}}^{i} \; rac{\partial oldsymbol{e}_{oldsymbol{k}}}{\partial oldsymbol{q}^{i}}$$

$$\Rightarrow w^j = \ddot{q}^j + \sum_{k,j} \dot{q}^k \dot{q}^i \, \Gamma^j_{ki}$$

$$ho$$
 $\Gamma_{j,\,ki} = rac{\partial oldsymbol{e_k}}{\partial q^i} \cdot oldsymbol{e_j}$ — I рода

$$ho \; \Gamma^j_{ki} \; = rac{\partial oldsymbol{e_k}}{\partial g^i} \cdot oldsymbol{e^j} -$$
II рода

$$\Rightarrow w_{\ell} = \frac{\mathrm{d}}{\mathrm{d}t} \left(\frac{\partial}{\partial \dot{q}^{\ell}} \left(\frac{\dot{\boldsymbol{r}}^2}{2} \right) \right) - \frac{\mathrm{d}}{\mathrm{d}q^{\ell}} \left(\frac{\dot{\boldsymbol{r}}^2}{2} \right)$$

4. Про углы Эйлера

img/euler_ang.pdf

$$\triangleright \omega = \dot{\psi} \, i_3' + \dot{\theta} \, i_1'' + \dot{\varphi} \, i_3$$
$$\triangleright R(t) = R_0(t) + r(t)$$

$$riangleright v = v_0 + \omega imes r + v_r$$

$$\triangleright \mathbf{w} = \mathbf{w}_0 + \dot{\boldsymbol{\omega}} \times \mathbf{r} + \boldsymbol{\omega} \times (\boldsymbol{\omega} \times \mathbf{r}) + 2\boldsymbol{\omega} \times \mathbf{v_r} + \mathbf{w_r}$$

5.

6.

7.

8.

9. В поле центральной силы ¬

$$\triangleright u = 1/\rho.$$

⊳ Формулы Бине

$$\begin{cases} v^2 = c^2 \left(\left(\frac{\mathrm{d}u}{\mathrm{d}\varphi} \right)^2 + u^2 \right) \\ w_\rho = -c^2 u^2 \left(\frac{\mathrm{d}^2 u}{\mathrm{d}\varphi^2} + u \right) \end{cases}$$

10. $\langle ? \rangle \langle :$ set aflame $\rangle Д$ вижение твёрдого тела \neg

- $\triangleright \omega = 0$ поступательное
- $\triangleright v_0, w_0 = 0, \omega = \dot{\varphi} i_3$ вращение вокруг неподвижной оси
- $\triangleright v_0 \! \uparrow \! \omega$ винт
- \triangleright $\langle ? \rangle$ Как попало вокруг неподвижной точки $^1 \neg$ $\boldsymbol{\omega} = \boldsymbol{i_1} (\dot{\psi} \sin \theta \sin \varphi + \dot{\theta} \cos \varphi) +$ $+i_2(\dot{\psi}\sin\theta\cos\varphi-\dot{\theta}\sin\varphi)+$ $+i_3(\dot{\psi}\cos\varphi+\dot{\varphi})$

11. Скорость и ускорение точек твердого тела

- $\triangleright v = v_0 + \omega \times r$
- $\Rightarrow \boldsymbol{w} = \boldsymbol{w_0} + \dot{\boldsymbol{\omega}} \times \boldsymbol{r} + \boldsymbol{\omega} \times (\boldsymbol{\omega} \times \boldsymbol{r})$
- 12. Сложение движений ТТ

$$\triangleright \ \boldsymbol{v_{r_n}} = \sum_{k=0}^{n-1} \left(\boldsymbol{v_k} + \boldsymbol{\omega_k} \times \overrightarrow{O_kO}\right) + \sum_{k=0}^{n-1} \boldsymbol{\omega_k} \times \boldsymbol{r_0}$$

$$riangleright V = \sum_{k=0}^{n-1} \left(oldsymbol{v_k} + oldsymbol{\omega_k} imes \overrightarrow{O_kO}
ight)$$

$$egin{aligned} ar{oldsymbol{V}} & = \sum_{k=0}^{n-1} \left(oldsymbol{v_k} + oldsymbol{\omega_k} imes \overrightarrow{O_kO}
ight) \ ar{oldsymbol{D}} & \Omega = \sum_{k=0}^{n-1} oldsymbol{\omega_k} & \Rightarrow oldsymbol{v_{r_n}} = oldsymbol{V} + oldsymbol{\Omega} imes oldsymbol{r_0} \end{aligned}$$

13. Кинематический винт

 $^{^{1}}$ У нас тут вроде косяк, а дальше снова как здесь ⟨ $\stackrel{\sim}{\sim}$ ⟩