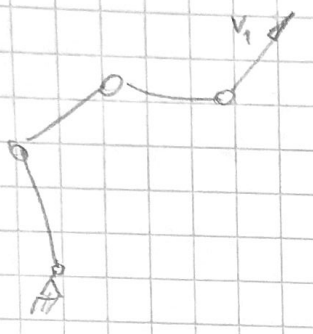

$$\underbrace{\in \{0, \pi\}}$$

$$e = \arccos(v_1, v_2) - d$$

$$\dot{e} = -\frac{v_2^T \dot{v}_1 + v_1^T \dot{v}_2}{\sqrt{1 - (v_1^T v_2)^2}}$$

$$\dot{e} = -\frac{1}{\sqrt{1-(v_1^T v_2)^2}} \underbrace{\left[v_2^T {}^v J^{v_1} + v_1^T {}^v J^{v_2} \right]}_{J^T} \dot{q}$$

$$J^T \qquad \dot{J}^T$$

$${}^v J^{v_f} = \left[k_1 \times v_{f_1} \cdots k_n \times v_f \right]$$

$$\dot{J}^T = -\frac{1}{\sqrt{1-(v_1^T v_2)^2}} \left[\dot{v}_2^T {}^v J^{v_1} + v_2^T {}^v \dot{J}^{v_1} + \dot{v}_1^T {}^v J^{v_2} + v_1^T {}^v \dot{J}^{v_2} \right]$$

$$- \left[v_2^T {}^v J^{v_1} + v_1^T {}^v J^{v_2} \right] \frac{v_1^T v_2 \left(\dot{v}_1^T v_2 + v_1^T \dot{v}_2 \right)}{\left(1 - (v_1^T v_2)^2 \right)^{3/2}}$$

$$\dot{J}^T = -\frac{1}{\sqrt{1-(v_1^T v_2)^2}} \dot{J}^T - \frac{v_1^T v_2 \; J^T \dot{q}}{\left(1 - (v_1^T v_2)^2 \right)^{3/2}} J^T$$