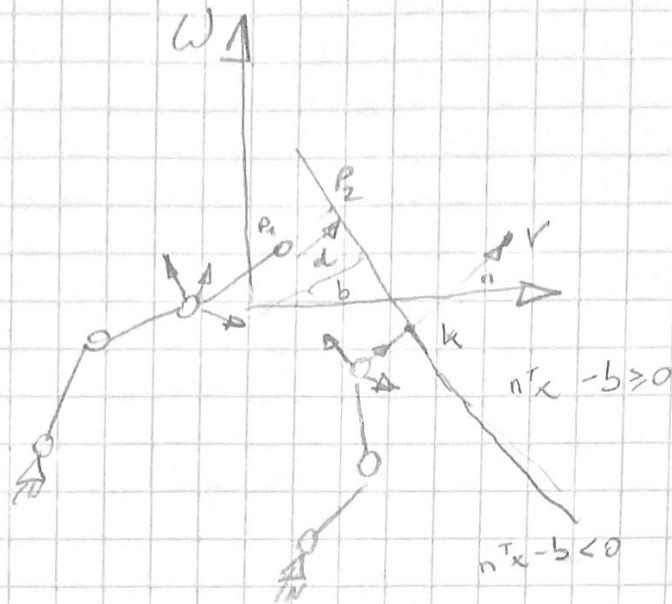


$$e = n^T p_1 - b$$

$$\dot{e} = \dot{n}^T p_1 + n^T \dot{p}_1 - \dot{b}$$



$$n^T k \leq b \Rightarrow \dot{b} = \dot{n}^T k + n^T \dot{k}$$

$$\dot{n} = \Delta J^{nk} \dot{q} \rightarrow \Delta J^{nk} = J^v - J^k$$

$$\dot{k} = J^k \dot{q}$$

$$\Rightarrow \dot{b} = (\Delta J^{nk} \dot{q})^T k + n^T J^k \dot{q}$$

$$\Rightarrow \dot{e} = (\Delta J^{nk} \dot{q})^T p_1 + n^T J^{p1} \dot{q} - (\Delta J^{nk} \dot{q})^T k - n^T J^k \dot{q}$$

$$= (\Delta J^{nk} \dot{q})^T (p_1 - k) + n^T (J^{p1} - J^k) \dot{q}$$

$$\dot{e} = \underbrace{[(p_1 - k)^T \Delta J^{nk} + n^T (J^{p1} - J^k)]}_{J^T} \dot{q}$$

$$\ddot{e} = J^T \ddot{q} + \dot{J}^T \dot{q}$$

$$\dot{J}^T = (p_1 - k)^T \Delta \dot{J}^{nk} + (p_1 - k)^T \Delta J^{nk} + \dot{n}^T \Delta J^{p1} + n^T \Delta \dot{J}^{p1}$$

$$\dot{J}^T = (\Delta J^{pk} \dot{q})^T \Delta J^{nk} + (\Delta J^{nk} \dot{q})^T \Delta J^{pk} + (p_1 - k)^T \Delta \dot{J}^{nk} + n^T \Delta \dot{J}^{pk}$$

$$J^T = (p_1 - k)^T \Delta J^{nk} + n^T \Delta J^{pk}$$