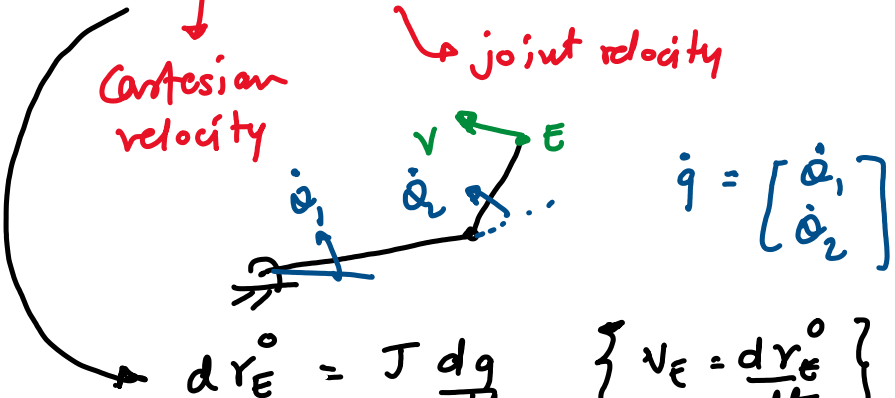
## ③ Inverse kinematics using Jacobian

Theory : $v_E = J\dot{q}$

Cartesian velocity

joint velocity




$$\frac{dr_E^o}{dt} = J\frac{dq}{dt} \quad \left\{ v_E = \frac{dr_E^o}{dt} \right\}$$

$$dr_E^o = J\,dq$$

$$\Rightarrow dq = J^{-1}\,dr_E^o$$

$$dq = J^{-1}\left\{ r_{ref} - r_E^o \right\}$$

$dq$: change in $q$

$r_{ref}$: reference position

$r_E^o$: measured

$$dq = J^{-1}\left[r_{ref} - r_E^0\right]$$

$$\begin{bmatrix} x_{ref} \\ y_{ref} \end{bmatrix} \qquad \begin{bmatrix} x \\ y \end{bmatrix}$$

To trace a reference

$$q \longrightarrow q + dq$$