로봇공학 5장 과제

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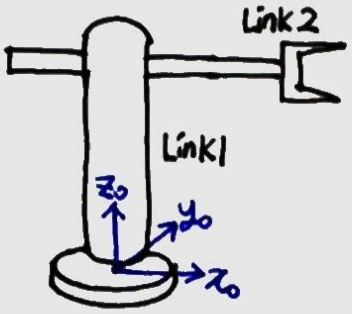
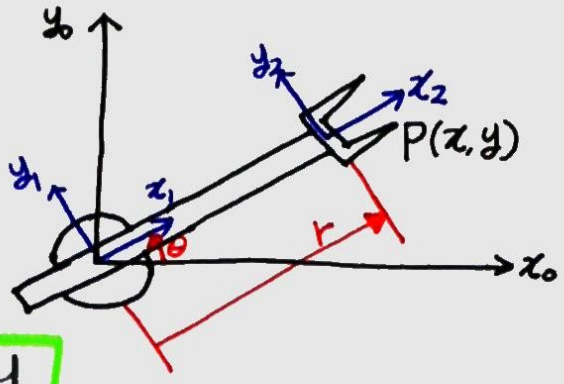
H/W.





— : Frames
— : Parsed Vars

{ Cartesian Var's : x, y
Joint Var's : θ, r

i) Forward Kinematics

$$\begin{cases} x = x(\theta, r) = r\cos\theta \\ y = y(\theta, r) = r\sin\theta \end{cases}$$

ii) Jacobian

$$J = \begin{bmatrix} \frac{\partial x}{\partial \theta} & \frac{\partial x}{\partial r} \\ \frac{\partial y}{\partial \theta} & \frac{\partial y}{\partial r} \end{bmatrix}, \quad \begin{Bmatrix} \dot{x} \\ \dot{y} \end{Bmatrix} = J \cdot \begin{Bmatrix} \dot{\theta} \\ \dot{r} \end{Bmatrix}$$

$$\Rightarrow \begin{Bmatrix} \dot{x} \\ \dot{y} \end{Bmatrix} = \begin{bmatrix} \frac{\partial x}{\partial \theta} & \frac{\partial x}{\partial r} \\ \frac{\partial y}{\partial \theta} & \frac{\partial y}{\partial r} \end{bmatrix} \cdot \begin{Bmatrix} \dot{\theta} \\ \dot{r} \end{Bmatrix}$$

… $\dot{u} = J(q) \cdot \dot{q}$ 꼴

iii) Inverse Velocity Kinematics

… $\dot{q} = J^{-1} \cdot \dot{u}$ 꼴

$$\begin{Bmatrix} \dot{\theta} \\ \dot{r} \end{Bmatrix} = \begin{bmatrix} \frac{\partial x}{\partial \theta} & \frac{\partial x}{\partial r} \\ \frac{\partial y}{\partial r} & \frac{\partial y}{\partial r} \end{bmatrix}^{-1} \cdot \begin{Bmatrix} \dot{x} \\ \dot{y} \end{Bmatrix} = \begin{bmatrix} -r\sin\theta & \cos\theta \\ +r\cos\theta & \sin\theta \end{bmatrix}^{-1} \begin{Bmatrix} \dot{x} \\ \dot{y} \end{Bmatrix} = -\frac{1}{r}\begin{bmatrix} \sin\theta & -\cos\theta \\ -r\cos\theta & -r\sin\theta \end{bmatrix} \begin{Bmatrix} \dot{x} \\ \dot{y} \end{Bmatrix}$$

$$\therefore \begin{Bmatrix} \dot{\theta} \\ \dot{r} \end{Bmatrix} = -\frac{1}{r}\begin{bmatrix} \sin\theta & -\cos\theta \\ -r\cos\theta & -r\sin\theta \end{bmatrix} \begin{Bmatrix} \dot{x} \\ \dot{y} \end{Bmatrix} \quad * r \neq 0$$

- $\begin{Bmatrix} \dot{\theta} \\ \dot{r} \end{Bmatrix}$ → Joint Velocity
- $-\frac{1}{r}\begin{bmatrix} \sin\theta & -\cos\theta \\ -r\cos\theta & -r\sin\theta \end{bmatrix}$ → J^{-1}
- $\begin{Bmatrix} \dot{x} \\ \dot{y} \end{Bmatrix}$ → end-effector Velocity