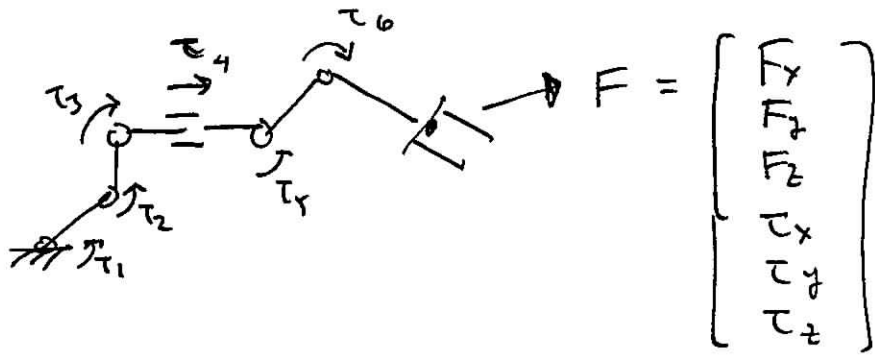


Status of the Jacobian

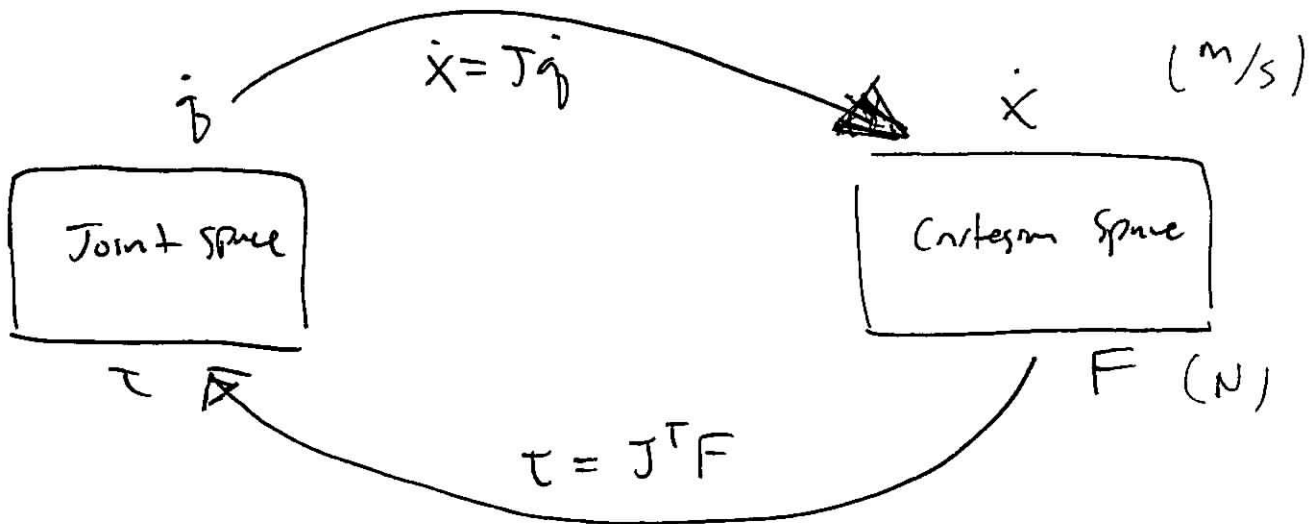


F : generalized force

$$\tau = \begin{bmatrix} \tau_1 \\ \vdots \\ \tau_n \end{bmatrix}$$

$$\tau = J^T \cdot F$$

Duality between Vector Velocity & Force



• Science of Motion

$$\dot{x} = f(x(t))$$

- Newton first to formulate fundamental laws of motion.

"second law of motion"

$$F = ma$$

• Why are interested in Dynamics?

1. Simulate robots $\tau \rightarrow q, \dot{q}, \ddot{q}$
Forward Dynamics

2. Control $q, \dot{q}, \ddot{q} \rightarrow \tau$
Inverse Dynamics



$$f = m\ddot{x}$$

Newton's second law

$$f(t) = ? \text{ Known}$$

$$x(t) = ?$$



$$\tau = I\ddot{\theta}$$

Euler's Second Law

$x(0)$

