Mathematical Notes on Robotics

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Appendix

0.0.1 Notations

- $x \in \mathbb{R}^n$ is a vector.
- $A \in \mathbb{R}^{m \times n}$ is a maxtrix.
- $p \in \mathbb{R}^3$ is the vector of position, $p = \begin{bmatrix} p_x \\ p_y \\ p_z \end{bmatrix}$.
- $R \in SO(3)$ is the rotation matrix.
- $g \in SE(3)$ is the rigid body transformation, $g = (R, p) \in SO(3) \times \mathbb{R}^3$. Alternatively, g can be represented in homogeneous coordinates $g = \begin{bmatrix} R & p \\ 0 & 1 \end{bmatrix}$, with $g^{-1} = \begin{bmatrix} R^T & R^T p \\ 0 & 1 \end{bmatrix}$.
- ϕ, θ, ψ are the ZYX Euler angles, ϕ- roll, θ-pitch, ψ-yaw.
- $q \in Q$ is the quaternion, $q = \begin{bmatrix} q_s \\ q_x \\ q_y \\ q_z \end{bmatrix}$.
- $\omega \in \mathbb{R}^3$ is the unit axis of rotaiton, $\|\omega\| = 1$, $\omega = \begin{bmatrix} \omega_1 \\ \omega_2 \\ \omega_3 \end{bmatrix}$.
- $\hat{\omega} \in so(3)$ is the skew-symmetric matrix, $\hat{\omega}^T = -\hat{\omega}$, $\hat{\omega} = \begin{bmatrix} 0 & -\omega_3 & \omega_2 \\ \omega_3 & 0 & -\omega_1 \\ -\omega_2 & \omega_1 & 0 \end{bmatrix}$