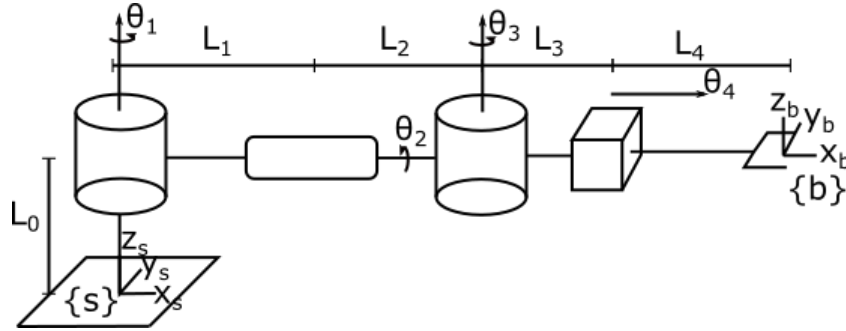


Problem Set 3

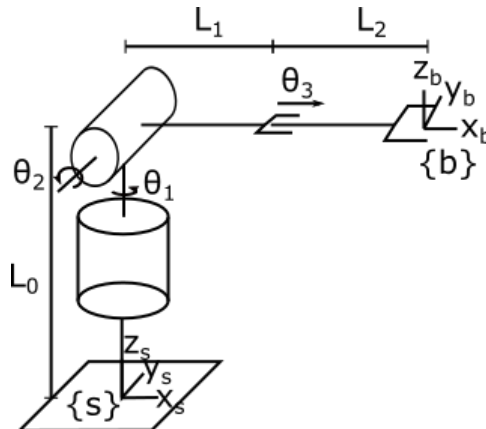
1 Problems

Problem 1. (2 points) Given the RRRP robot shown below, the shown configuration is the home position of this robot determine the following:



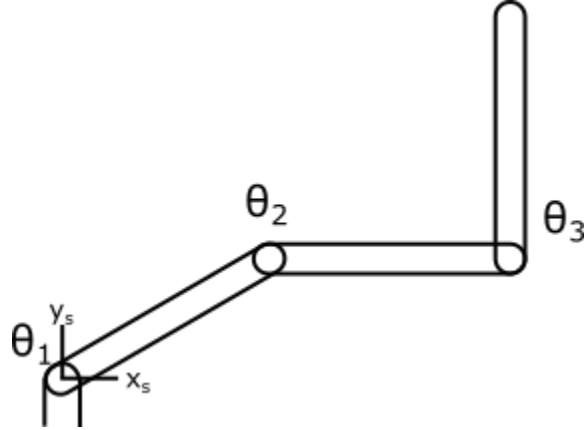
- The zero position configuration M
- The screw axis \mathcal{S}_i for each joint in the $\{s\}$ frame.
- The screw axis \mathcal{B}_i for each joint in the $\{b\}$ frame.
- Using the Product of Exponential method in either the space or body frame to find the end-effector configuration for the joint configuration $\theta_1 = \pi, \theta_2 = \frac{\pi}{2}, \theta_3 = \frac{\pi}{4}, \theta_4 = 2$

Problem 2. (1 points) For the RRP robot shown below in its home configuration determine the following:



- (a) The body Jacobian J_b
- (b) The space Jacobian J_s

Problem 3. (1 point) Given the 3R planar robot shown below in the given configuration with angles $\theta_1 = \frac{\pi}{4}, \theta_2 = 0, \theta_3 = \frac{\pi}{2}$, and link lengths all equal to $1m$, determine the required joint torques in order to apply $10N$ force in the y_s direction:



Problem 4. (1 points) Given the spatial 3R robot show in its zero configuration, determine the spatial twist \mathcal{V}_s of the tip with the joint configuration $\theta_1 = 0, \theta_2 = 0, \theta_3 = \frac{\pi}{4}$ and joint rates $\dot{\theta}_1 = 1, \dot{\theta}_2 = 1, \dot{\theta}_3 = 2$

