Initial Configuration

1. The default initial cube position in world frame is:

$$T_{sc,\text{initial}} = \begin{bmatrix} 1 & 0 & 0 & 1 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0.025 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

2. The default final cube position in world frame is:

$$T_{sc,\text{goal}} = \begin{bmatrix} 0 & 1 & 0 & 0 \\ -1 & 0 & 0 & -1 \\ 0 & 0 & 1 & 0.025 \\ 0 & 0 & 0 & 1 \end{bmatrix}.$$

The initial configuration of the robot is: [0.0, 0.2, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0]

Results

The overshoot results were obtained by tuning the proportional gain(Kp) to 2.0 and the integral gain(Ki) to 0.01.
As seen from the error plot there is a tiny error in the middle but converges after that. It overshoots slightly in the beginning around the 2.5 second mark as seen from the red loop but converges after that. There is a tiny error around the 12 second mark but as seen from the video, the robot is able to pick up and place the cube smoothly at the respective locations.

The Xerror plot is shown below: