Homework 5

(Due time: 10:00, May. 3, 2024)

1. Calculate $\dot{\theta}_{12}, \dot{\theta}_{23}, t_1, t_2$, and t_3 for a two-segment linear function with parabolic blends (LFPB). For this joint, $\theta_1 = 5.0°, \theta_2 = 15.0°, \theta_3 = 40.0°$. Assume that $t_{d12} = t_{d23} = 1.0$ seconds and that the default acceleration to use during blends is 80 degrees/second^2 . Use Matlab to sketch plots of position, velocity, and acceleration of θ. The derivation, Matlab code, and result graphs are required.

2. Use Matlab to sketch graphs of position, velocity, and acceleration for a two-segment spline where each segment is a cubic. Sketch them for a joint where $\theta_0 = 5.0°$ for the initial point, $\theta_v = 15.0°$ is a via point, and $\theta_g = -10.0°$ is the goal point. Assume that each segment has a duration of 2.0 seconds and that the velocity at the via point is to be 0.0 degrees/second. The derivation, Matlab code, and result graphs are required.

3. A single cubic trajectory is given by
$$\theta(t) = 10 + 90t^2 - 60t^3$$
and is used over the time interval from $t = 0$ to $t = 1$. What are the starting and final positions, velocities, and accelerations?

4. It is desired for the tool point to follow a linear trajectory with parabolic blends that starts at $P_1 = [0.0 \quad 0.0]^T$ and ends at $P_3 = [3.0 \quad 3.0]^T$, with $P_2 = [2.0 \quad 1.0]^T$ as a via point. The desired segment durations are $t_{d12} = t_{d23} = 1$ and the acceleration magnitudes are $\ddot{x} = \ddot{y} = 6$. Plot the x-y coordinates of this trajectory. The derivation, Matlab code, and result graphs are required.