Report

Dynamics of non linear robotic system

Homework assignment №4

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GitHub Link

The MatLab code you can find on this link:

https://github.com/rodosha98/DynamicsJacobian.git

Task 01

Initial parameters:

$q(0) = 1$ $\qquad\qquad$ $\dot{q}(0) = 0$

$q(2) = 4$ $\qquad\qquad$ $\dot{q}(2) = 0$

a. Polynomial position profile

General Expressions of polynomial(position and velocity):

$$q(t) = a_0 + a_1 t + a_2 t^2 + a_3 t^3$$

$$\dot{q}(t) = a_1 + 2a_2 t + 3a_3 t^2$$

Taking into account initial conditions, there can be written 4 equations:

1) $a_0 = 1$
2) $a_0 + 2a_1 + 4a_2 + 8a_3 = 4$
3) $a_1 = 0$
4) $a_1 + 4a_2 + 12a_3 = 0$

I've solved this system of equations in Matlab, using the linear system solver. The result you can see on the figures 1 and 2.

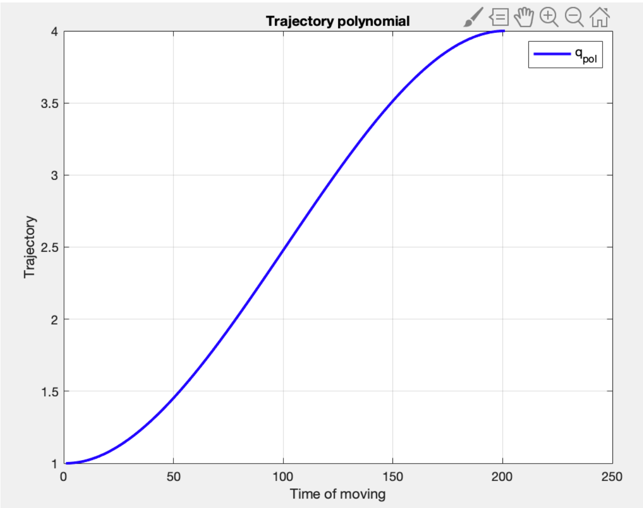
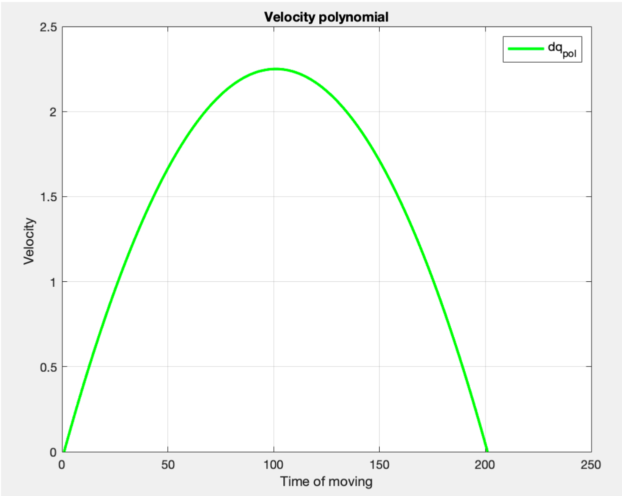


Figure 1 - 3 degree polynomial trajectory



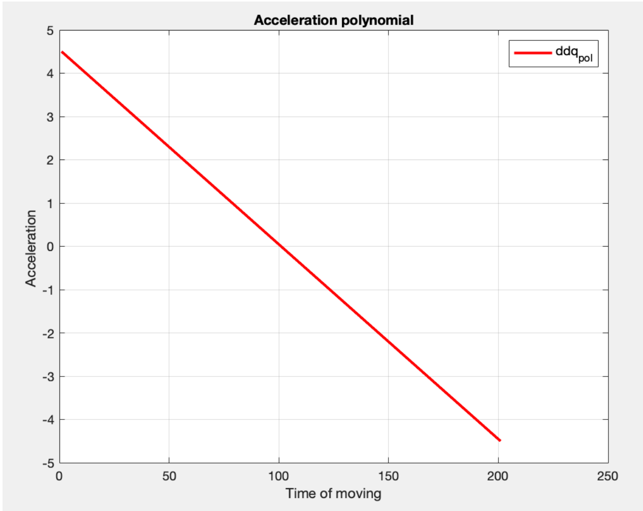


Figure 2 - Velocity and acceleration plots

As can be seen in the graphs, the initial conditions are satisfied, and also the speed has 2 degrees and the first is accelerated.

b.Trapezoidal profile

In trapezoidal profile we divide the task on 3 areas, corresponding velocity plot. Initial and finite areas are similar, and in the middle - constant velocity zone.

The first step is to define time moment t_c, where velocity becomes constant.

Initial parameters: q_i, q_f and additional parameter. There are needed additional assignments and we have to approaches:

1) Assign desired acceleration

Condition for acceleration:

$$|\ddot{q}_c| \geq \frac{4|q_f - q_i|}{t_f^2}$$

If equality, there will be no constant segment on profiles.(triangle)

Then:

$$t_c = \frac{t_f}{2} - \frac{1}{2}\sqrt{\frac{t_f^2\ddot{q}_c - 4(q_f - q_i)}{\ddot{q}_c}}$$

2) Assign desired constant velocity

I've implemented 2 this approach via flag. If flag is equal to 1 - that means velocity approach, 0 - acceleration.