Sharif University of Technology
Department of Electrical Engineering
Assignment 2 for Robot Control 1

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Problem 1: Consider the 6-DOF robot of Assignment 1. We would like EF of the manipulator to track a spiral trajectory of the form $z_d(t) = 0.2\sin(t)$, $y_d(t) = 0.2\sin(t)$, $x_d(t) = 0.2+0.2\cos(t)$. Orientation of the EF should be similar to the fixed frame, O_0 for all time. Assume that $\max_t |\tau_i(t)| \le 30\text{Nm}$.

  a. Assume that manipulator dynamics is known and design a Slotine controller for achieving asymptotic motion tracking.

  b. Assume that mass of the last motor is uncertain. Design an adaptive controller to achieve asymptotic motion tracking.

  c. Investigate the effect of controller gains and parameter adaptation gain on tracking error and parameter convergence.

  d. Assume that friction exists in the second joint and it is given by

$$\tau_{f_2} = (10 + d)\dot{q}_2 + (2 + d)\,\text{sgn}(\dot{q}_2)$$

  where $d(t)$ is a white noise with $|d(t)| \le 1$. Investigate the effect of friction on the adaptive controller of part b. (Don't compensate the friction torque by the controller).

  e. Assume the friction torque as unmodeled dynamics in part b. Compensate the effect of friction torque by smooth and non smooth robust adaptive controllers.