

ME 449 Assignment 5

Due 1:30 PM, Monday November 24, 2025

1. Exercise 6.7. Hand draw no more than three iterations which make it clear which root is being converged to.
2. Exercise 6.8.
3. Exercise 8.2.
4. You derive the Lagrangian $\mathcal{L}$ for a two-joint robot. The Lagrangian is the sum of several terms, $\mathcal{L} = \mathcal{L}^1 + \mathcal{L}^2 + \dots$. One of these terms is $\mathcal{L}^1 = \mathbf{m}_2 L_1 L_2 \dot{\theta}_1^2 \cos \theta_2$. Use the Euler-Lagrange equation to find the contribution of this term of the Lagrangian to the joint torques τ_1 and τ_2 . For each term in your results, label it as a mass matrix term (i.e., it would appear in $M(\theta)\ddot{\theta}$), a velocity product term, or a potential term.
5. Describe the Newton-Euler inverse dynamics for a robot arm in intuitive plain English, assuming the reader understands the Newton-Euler dynamics of a rotating rigid body. There are three equations in the forward iterations and two equations in the backward iteration. For each term that appears on the right-hand side of each of the five equations, provide approximately one plain English sentence justifying why that term appears or makes sense.
6. Exercise 9.1.
7. Exercise 9.3.
8. Exercise 9.21.
9. Exercise 9.22.
10. Exercise 11.6.