

Force Fields - Answers

Q1: Attractive and Repulsive Fields

- **Attractive field:**

$$F_{\text{attr}} = -K (p - p_{\text{Home}})$$

This pulls the end effector toward the home position.

- **Repulsive field:**

$$F_{\text{rep}} = +K (p - p_{\text{Home}})$$

This pushes the end effector away from the home position.

Q2: Viscous Field (Damping Force)

$$F_{\text{viscous}} = Dv$$

This opposes velocity, reducing movement and increasing stability.

Given Matrices:

$$K = -20 * \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 0 \end{bmatrix}$$

$$D = -20 * \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 0 \end{bmatrix}$$

Torque Conversion for Simulink:

The computed forces are converted into torques using the Jacobian:

$$\tau = J^T F$$

where F is the total force, given by:

$$F = F_{\text{attr}} + F_{\text{viscous}}$$