**LQR Controller for AUV Depth Regulation**

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In this phase, an LQR (Linear Quadratic Regulator) controller was designed to regulate the depth of the AUV using a linearized model of the system. The purpose was to design a controller that minimizes a quadratic cost function while ensuring stability and performance.

**System Model:**

The linearized state-space representation is:

with the matrices:

**LQR Design:**

The controller minimizes the cost function:

With selected weights:

* *Q = diag(100, 1)*
* *R = 0.01*

Using MATLAB’s lqr function, the optimal gain matrix K was obtained. The closed-loop control law is:

**Simulation Result:**

The resulting depth response of the AUV shows excellent stability. The system remains at the zero-depth position with no oscillation, overshoot, or drift — confirming a well-tuned controller.

Figure\_LQR Depth Response

