Fuzzy Logic Controller for Nonlinear AUV Model

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In this phase, we designed and implemented a Fuzzy Logic Controller (FLC) for the nonlinear dynamics of an Autonomous Underwater Vehicle (AUV). The objective was to control the depth of the AUV based on the error and the derivative of the error with respect to the reference depth.

Key Highlights:

- A Mamdani-type FLC was created using MATLAB's fuzzy toolbox.
- Input variables: Depth error (e) and error derivative (de).
- Output: Control signal (u).
- A rule base was constructed using expert knowledge to handle nonlinear behavior.
- The controller was integrated into the nonlinear model, and simulations were performed.

Simulation Results:

The response of the AUV's depth shows:

- An initial overshoot up to around 4.5 meters.
- A series of damped oscillations.
- Convergence to the reference depth (3 meters) over time.

This demonstrates that the fuzzy logic controller effectively stabilizes the AUV's depth with smooth convergence.

Figure1_Response of the AUV depth under fuzzy control.

AUV Depth Response with Fuzzy Controller