

ECSE 6965

Assignment 4

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1) Explain how you discretize the state-action space and why this approach makes sense when it comes to finding a good controller.

The state-action space is discretized by selecting predefined values for parameters p_1 , p_2 , a_1 , a_2 , and a_3 , which represent position thresholds and action decisions. This discretization reduces the continuous search space into a finite set of combinations, allowing for systematic exploration of controller strategies.

This approach is effective because:

- **Simplified search:** It makes the optimization problem computationally feasible by reducing the number of possible controllers.
- **Structured exploration:** It ensures that different regions of the parameter space are explored, preventing the algorithm from missing potential high-performing controllers.
- **Efficient trade-off:** Discretization balances precision and complexity, enabling faster experimentation without overly compromising on control quality. We can do this trade-off by choosing how many divisions we want to perform to the state and action space.

2) Why does using the UCB algorithm make sense for this application? What guarantees does the UCB algorithm provide?

The UCB (Upper Confidence Bound) algorithm is appropriate here due to its balance between exploration and exploitation:

- **Exploration vs. Exploitation:** UCB selects controllers based on their estimated reward and uncertainty, encouraging exploration of under-tested controllers while exploiting high-performing ones.
- **Mathematical guarantees:** UCB minimizes regret, ensuring that over time, the algorithm's performance approaches that of the optimal controller. It balances learning and performance improvement efficiently.
- **Efficiency:** UCB provides a simple, principled way to select controllers, ensuring logarithmic regret and convergence towards the optimal solution over time.