OLCAR - Exercise 1 – ILQC

Answers to question related to programming exercise

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# Problem 1

Design LQR controller with one goal state (2.)

Question 1: How does the controller behave with varying positions of the Task.goal\_x?

Question 2: What is the cause of the varying performance (model, cost function,...)?

Question 3: How do changes in Task.cost.Q\_lqr and Task.cost.R\_lqr affect the behavior?

Task.cost.Q\_lqr (further on named Q) penalize the distance the object is away from the goal position, while Task.cost.R\_lqr (further on named R) penalizes the control effort it takes to come there. As a result of this, the cost matrix Task.cost.Q\_lqr influences the speed the quadrocopter reaches the goal position, while the cost matrix Task.cost.R\_lqr has influence on the control effort.

Choosing Q and R is a trade-off between these two issues.

Design LQR controller with a via-point (3.)

Question 4: How does a via-point change behavior of the LQR controller?

Until a certain time Task.vp\_time the controller only aims to reach the intermediate via point Task.vp1. After this time, the cost function differs.

Question 5: Why is the system capable of reaching further away Task.goal\_x states?

Because of the dynamic cost function.

Question 6: Defining via points Task.vp and time Task.vp\_time seem to have a positive influence on the system behavior and increase stability. What are the disadvantages?

# Problem 2

Design the ILQC controller (1.)

Question 7: How do the trajectories of the LQR and ILQC controller di\_er? How do the costs

compare?

Question 8: Why does the ILQC perform better for distant and similarly well for close goal states?

Include via-points for the ILQC controller to pass through (2.)

Question 9: How must the via-point weighting matrix Q\_vp be chosen for the algorithm to determine the optimal via-point velocity on its own?

Question 10: How can exact passing through the via point be enforced and how can it be included only as a soft suggestions on top of the other performance criteria?