Optimizing PID With BO

Bayesian Optimization For the Panda Arm

- In this lab session, you will use Bayesian Optimization to optimize the PD gains for all the joints for the feedback linearization controller

- First, install the package necessary for this session in roboenv by typing in roboenv2 this command

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pip install scikit-optimize

- Ensure that the In the **config file** both damping, spring, delay, and noise are **deactivated**
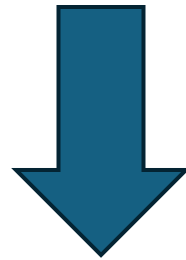
Bayesian Optimization For the Panda Arm

- The code is available here:

- https://github.com/VModugno/lab_sessions_COMP0245_PUBLIC/tree/main/week_3

Lab Session Objective (1)

- Complete the black box objective functions by inserting the simulator function inside it

```python
def simulate_with_given_pid_values(sim_, kp, kd, episode_duration=10)
```

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```python
def objective(params):
```

Lab Session Objective (2)

- test different acquisition functions ('EI', 'PI', 'LCB',) in the gp_minimize function.

```
result = gp_minimize( objective, space, n_calls=50,base_estimator=gp,acq_func='EI', # LCB': 'EI': 'PI':
                      random_state=42)
```

- For each
  - Run the optimization and record the cost function results values
  - Compare the convergence behavior and final tracking error.
  - Determine which acquisition function performs best for this problem.

Lab Session Objective OPTIONAL (3)

- For each Bayesian Optimization Iteration collect the data of the first element in the Kp and in the Kd vector and fit a GP function

- Plot the result obtained and analyze the effect of the parameter of the RBF kernel on the GP regression (use values "small" and "large")

- To update the RBF hyperparamenter update the function

```
def fit_gp_model(kp0_values, kd0_values, tracking_errors):
```

The function is contained in gp_functions.py

Lab Session Objective (OPTIONAL) (4)

- Update the config file:
- Add the damping on every joint and use the same value from Ziegler-Nichols
- Add delays with the same value of Ziegler-Nichols
- Use the best acquisition function to find the optimal parameters
- Make it works :)