Advanced Robotics – Week 10 Workshop

Task 1: Learning Linear Dynamic Systems

For this task we will develop the code for training linear stable dynamic systems using Python. The objective is to implement the methods that are currently not implemented

Steps:

1. Download the Learning_Linear_DS folder from Blackboard. This contains the code (main.py) and some demonstrations of motions(csv files)
2. Familiarize yourself with the code and read the inline documentation carefully to understand what operations should be performed in each of the methods
3. Implement the motion_model method. This should return the predicted velocities from the linear dynamical system (v = Ax)
4. Implement the Lyapunov_constrains method. This method is used in constrained optimization, to check if the desired constraints are satisfied.
5. Implement the objective_fun method. This method calculates the error between the velocities predicted from the linear dynamical system and the demonstrated. Output of this function is minimized by the optimization method
6. Implement the train_ds method. This method should optimize the objective function with respect to the constraints.
7. Train models for all the demonstrated trajectories (Angle.csv, CShape.csv, Line.csv, Sshape.csv, WShape.csv)
8. Which of the demonstrated trajectories are not modelled accurately by the linear dynamical system? Why?

Task 2: Fitting GMMs on Demonstration

For this task we will use the sklearn package implementation of the GMMs. You can find it here.

Steps:

1. Load the demonstrations of trajectories and fit a GMM on them
2. Try different numbers of components and get the GMM likelihood for each of them
3. Choose the optimal number of components based on a good complexity-accuracy trade-off