Homework #3- Machine Learning for Robotics (RBE 577)

Dubins Airplane Trajectory Prediction with RNN

The goal of this homework is to train a recurrent neural network to predict the trajectory of a Dubins airplane.

Dubins airplane is an extension of the classical Dubins car model for the 3D case of an airplane. A simplified version of the Dubins airplane is used in this homework that does not enforce the goal's heading.

You are given a MATLAB function called "dubinEHF3d" that given the current pos and the goal location, predicts the 3D trajectory points sequence. Please watch the accompanying video about how the function works.

You need to generate your own dataset using the above model and split them into 80/20 train and validation set. To generate the data using the function "dubinEHF3d", set the current pos at $\{x = 0, y = 0, z = 0\}$ and vary the goal's $\{x, y\}$, the initial heading, $\psi \in [0, 2\pi]$, and the climb angle $\gamma \in [-30\ deg, +30\ deg]$.

Notes:

- You may experiment with various architectures such as vanilla RNN, LSTM, GRU.
- You need to apply proper regularization techniques that were discussed in the lectures to avoid overfitting and underfitting.

Team Collaboration:

- Teams of two can collaborate on the homework.

Final Deliverables:

1. Python code for the implementation along with a readme file containing the python version and version of all the packages used and how to run the code.
2. Using Tensorboard, you need to provide plots of loss function in training and validation data set as a function of epoch.
3. 10 example plots of the predicted trajectory with the Neural network and the ground truth using the function "dubinEHF3d".
4. The pdf of the final report. It should contain the explanation of your methodology, loss function used, neural network architecture, lesson learned, all the plots, and hyperparameters of the neural network.