EN.530.626: Trajectory Generation for Space Systems
Homework 5
Due Nov 20th 11:59PM

The code for this assignment can once again be found on GitHub at this link and can be downloaded by running `git clone https://github.com/JHU-ACEL/trajdesign_hw.git` from a terminal window. Due to a change in the `Dockerfile` to support a mixed-integer programming solver, you will have to rebuild your `Docker` image. Homework submissions and grading will be managed through Canvas.

Introduction

This homework will focus on the following technical concepts:

1. The challenges associated with solving optimal control and motion planning problems for nonlinear systems such as the bicycle model.
2. Learning about stochastic optimization techniques, specifically Model Predictive Path Integral (MPPI) and Cross Entropy Method (CEM), to efficiently compute control inputs that guide a vehicle towards a desired goal.

To accomplish this, the software development learning goals include:

- Gaining familiarity with implementing sampling-based stochastic optimization algorithms for trajectory generation and control.
- Applying MPPI and Cross Entropy Method to guide the states of a bicycle model to reach a target location in a simulated environment.

Problem 1: Derivative-Free Trajectory Optimization

In this problem, you will implement two gradient-free trajectory optimization algorithms—Model Predictive Path Integral (MPPI) and the Cross Entropy Method (CEM)—to guide a bicycle model toward a specified goal.

Submission Instruction

- Download the marimo notebook for each problem and join them together into a single PDF or HTML file named `hw5.pdf`.
- Compress the `hw5` folder containing all your python files. Name this file "hw5.zip".
- Upload both the PDF/HTML file and the zip folder into the canvas assignment "`Homework 5`".