

Overview

We want to simulate an autonomous driving system controlled by neural network. To do this, at the first step, we have decided to implement a feedforward neural network which has distance sensor readings as input and use genetic algorithm to evolve. At the next step, we plan to implement a GPU accelerated convolutional neural network which has camera images as input. Image pre-processing will also be accelerated by GPU. Since path planning and Trajectory Planning is an important feature for autonomous driving, we want to implement a GPU accelerated version of it as well.

Because the car driving not only has to obey the real world physical and consider onroad environment but also relies on CUDA and compute shader to accelerate computing, so we decide to use Unity 3D. We could attempt to use OpenGL or Vulkan to render the scene but building a changeable environment with complex vehicle physical is extremely time consuming. The Unity 3D natively support GPU compute shader and relatively easy to write a library which could use CUDA functions, besides it can handle the vehicle physics and construct the environment pretty well.

Once we complete the autonomous driving system, we also would like to try to implement some other features. In the NVIDIA autonomous driving presentation, the vehicle is able to detect the road condition in real time. We would like to start from a basic level and try to detect objects on road and change its movement accordingly. Moreover, we want to try to generate point cloud of the surroundings using compute shader.

Goals

- ❖ GPU accelerated Artificial Neural Network
- Feed Forward (weekly milestone 11/20 & 11/27)
- Convolutional Network (weekly milestone 12/04 & 12/11)
- ❖ Generic Algorithm (weekly milestone 11/20)
- ❖ GPU accelerated Path Planning and Trajectory Planning(weekly milestone 11/20 & 11/27)
- ❖ Image Pre-Processing with Compute Shader (weekly milestone 11/27 & 12/04)

Stretch Goals (weekly milestone 12/04)

- ❖ Point Cloud Generation with Compute Shader for Environment Recognition
- ❖ Obstacle Avoidance

References

1. <https://www.nvidia.com/en-us/self-driving-cars/>
2. <http://cs231n.stanford.edu/>
3. <http://ieeexplore.ieee.org/abstract/document/930309/>

