**Monday, August 28, 2023**

Last Friday, we discussed my ideas for the project and narrowed it down to doing real-life reinforcement learning with the 1/10 scale cars, with the objective of creating a learned behavior for following a moving target without crashing. Normal simulator-based reinforcement learning to solve this problem would not be directly applicable to reinforcement learning in real life. Furthermore, reinforcement learning is extremely sample inefficient, and the physics simulators used typically run orders of magnitude faster than real life when simulating. Thus, I am researching methods to make a more sample-efficient process which can prevent the car from crashing when it fails to keep the car away from obstacles. One promising method is called “[Learning to Drive in a Day](https://arxiv.org/pdf/1807.00412.pdf)”, which has been implemented in simulation. The underlying idea is using a VAE (Variational Autoencoder) to extract relevant features from a picture into a latent space and incorporating a decoder to de-construct those features into a steering and throttle value to operate the car. The interesting part is that the training of the encoder and decoder can be de-coupled – the encoder can be trained through imitation learning. This is manually driving the car to collect training data for the encoder. Once the encoder is trained, the rest of the network (the decoder) can be trained using a reinforcement learning technique using Deep Deterministic Policy Gradients (DDPG). This eliminate the early learning stages of reinforcement learning, where a car will take random actions, causing it to crash frequently (which is a problem when taking away the simulation aspect). The other aspect of this problem which I have been researching is the sensing and hardware aspect. A key focus of the project, especially the demonstration and final presentation, will be on showing that the car can successfully follow a moving target such as a walking human. Thus, I will need to know the spatial relationship between the car and target in real life. I believe that stereo cameras will be the best option for this. In particular, the OAK-D cameras have the ability to run neural networks such as MobileNet or ResNet with spatial object detection – if they are available in the SysLab it would eliminate a lot of the low-level hardware considerations.