Autonomous Navigation Through Reinforcement Learning

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Abstract

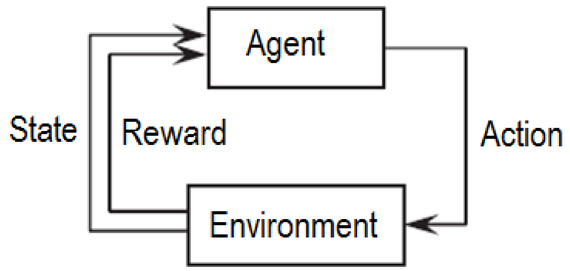
Autonomously navigating and completing tasks is a challenging goal and still a large focus of research and development. The process of designing control algorithms for autonomous agents lends itself well to machine learning, in particular reinforcement learning, a style of machine learning requiring no labeled data, instead utilizing a reward function for training. The goal of this project is to implement an autonomous mobile robot that will navigate to a GPS target while avoiding obstacles in its environment. This will be done using deep reinforcement learning in a simulated training environment.

Background

The applications for autonomous mobile robots in industry is massive and demand is rapidly growing. Advances in this field are being made by top tier institutes and companies such as Intel, Amazon, and DeepMind. Contributions to this research could have a meaningful impact on daily life in the near future.

Deep Q Learning

Reinforcement Learning involves sequential decision making. It requires no labeled data.. Combined with the power of neural networks, it has been proven to be highly robust and adaptable to new situations and environments. A simplified diagram of the process is shown below.



Training Environment

3D simulator — Robotics framework — Machine learning toolkit

GAZEBO ROS OpenAI

These three tools come together to create a simulated training environment for the machine learning model.

Results

Successful training on environments with static obstacles was achieved. The above graph shows score per episode improvement. The variation in the later half is due to normal random choice making during the training. process

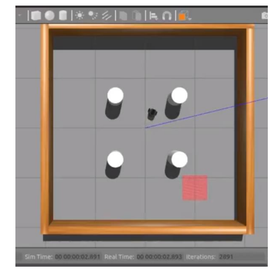
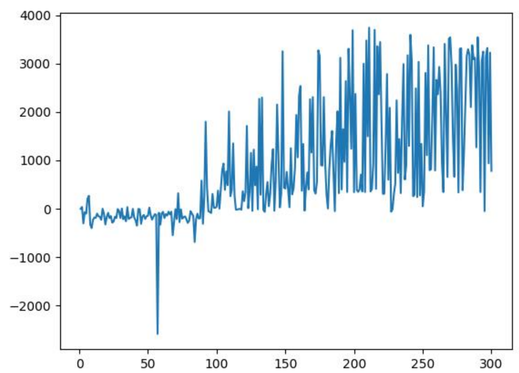


Image of training simulation



Score per Episode over training period

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