2R Manipulator with Reinforcement Learning

Giang Dao

April 9, 2019

In robotics, people try to convert complex and high dimensional information to describe in lower dimensional context where the information is collected from expensive sensors. After transforming the information, a problem is solved the problem with a very complex math. This method high-to-low dimensional transformation can lead to a data loss problem. This method also brings a problem of scalability in which a slightly different problem might require researcher manually solve and setup a machine to work differently. There is another difficulty in robotics that is how to describe an object looks like in robotics term.

In this project, I will create a simulation of a 2R manipulator with 3 controllable joints (2 links and 1 gripper) to reach a certain goal with extract orientation. To get more challenge, the simulation produce image as input instead of using direct joints angle, arm links, as well as goal image. I hope to deliver a deep reinforcement learning method to solve a path generation for this simple problem. This learning method is an end-to-end method which is not required handcraft information or any complex math involved. The method will take input of images (RGB image for manipulator configuration and gray scale image for goal configuration) and output a three dimensional vector corresponding to each rotation joint.

In the simulation, the 2R manipulator can take up to 50 interactions to reach the goal configuration before the simulation resets to different random manipulator and goal configurations. Each interactions consists of controlling 3 joints which is constrained to range only from $[\frac{-\pi}{18}, \frac{\pi}{18}]$. Each interaction will receive a reward of -1 except for the interaction that reaches goal configuration receives a reward of 0. Figure 1 shows an example of the simulation.

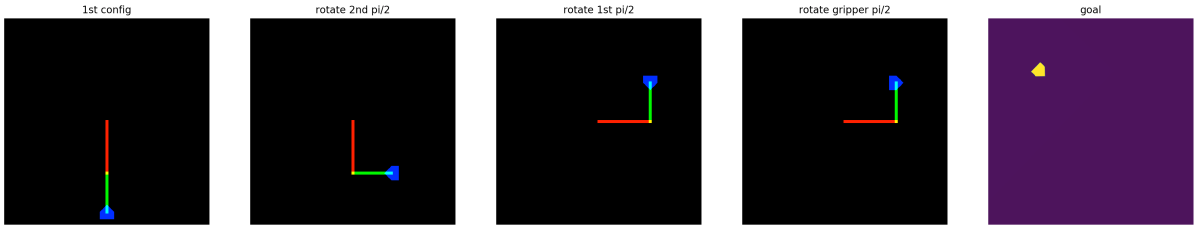

Figure 1: Movement samples of the 2R manipulator simulation with a sample goal configuration.