Robot arm training by image processing and reinforcement learning

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Abstract

In this thesis, firstly, I propose a system that enables a robotic arm to grasp a ball based on its camera image. My developed algorithm detects the ball in the image and then calculates its position in a fixed global coordinate system of the robotic arm. My results show that my system is able to accurately detect and grasp the ball with high success rate. Here the thesis discusses the used inverse kinematics and coordinate system transformation.

In my second, more complex task, my goal was to teach a robotic arm to build a tower of cubes starting from randomly positioned cubes on a table. In the thesis I have developed the core theoretical framework of training the robotic arm using hierarchical reinforcement learning and options. I presented the optimization of policy parameters for one crucial subtask, namely reaching the cube. The policy of the reaching task was trained by the Proximal Policy Optimization algorithm. The thesis goes through policy gradient methods - vanilia policy gradient, natural policy gradient method, Trust Region Policy Optimization (TRPO) and finally the Proximal Policy Optimization algorithm.