Robotics and Embedded Systems

KI.FABRIK

Master/Bachelor Thesis

Deep Reinforcement Learning Enhanced Image-based Visual Servoing for Robotic Manipulators

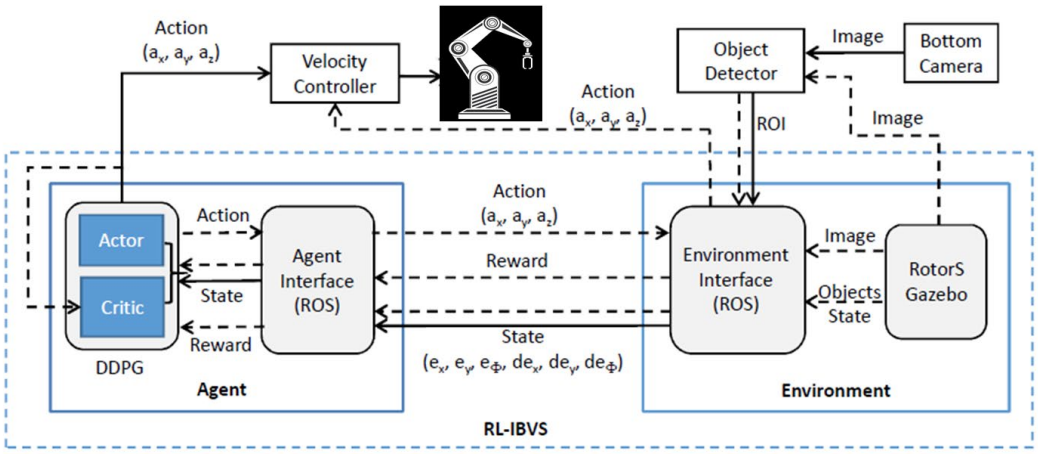
Background

Image-Based Visual Servoing (IBVS) has been the subject of extensive research over the years. IBVS finds applications in various tasks, such as tracking objects, grasping and manipulating objects, and performing inspection tasks. Despite numerous efforts, the traditional IBVS approach, which maps visual errors to actuator commands, still faces challenges in achieving convergence, stability, and designing appropriate gain values. Deep reinforcement learning (RL) has recently proven highly successful in modeling complex behaviors, creating a promising opportunity to integrate it with IBVS to provide innovative solutions for a wide range of real-world robotic tasks. However, integrating IBVS and RL within a unified framework for enhancing control in practical applications presents a significant challenge. In this work, you will demonstrate a novel IBVS controller for manipulators based on deep RL. The RL-IBVS controller will be trained and tested in simulated scenarios. Validation and comparison of the proposed RL-IBVS approach with respect to classic IBVS controllers will be conducted in simulated and real manipulators.

Your Tasks

In this thesis, you will develop an IBVS controller for manipulators using deep reinforcement learning that tries to solve tasks in a practical environment, such as multi-manipulation tasks in the MetaWorld benchmark. To be specific:

1. You will learn knowledge about machine vision, RL, and traditional control methods.
2. You will work on the basis of our current algorithm and develop a novel algorithm.



The framework of IBVS control of manipulators with deep RL

Requirements

- High self-motivation and passion for research.
- Six months working time.
- Existing knowledge about machine vision, RL will be a bonus

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