RUHR-UNIVERSITÄT BOCHUM

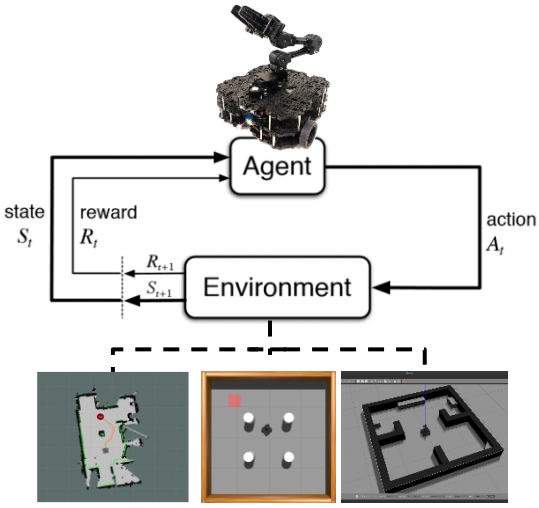
Master Thesis

Topic: Reinforcement Learning for Navigation and Arm Manipulation Task of an Autonomous Robot

Description:

Reinforcement learning (RL) is a paradigm of artificial intelligence that mimics natural way of learning from experiences. Use and popularity of RL skyrocketed after Mnih. V. et al. [1] showed that it can achieve human level performance in multiple classic Atari games. Since then, RL with deep neural networks have been used a lot for control and robotics [2].

The objective of this work is to explore and implement different RL techniques efficiently to train an intelligent agent that can control a robot to navigate, pickup and place items in an environment. Turtlebot3 with manipulator [3] will be used as the robot. At first the full implementation should be performed in simulation using Gazebo simulator and then the trained controller must be implemented in the real robot system. In our lab, navigation using RL techniques like DDPG and DQN have already been implemented successfully in environment with and without obstacles [4]. The main goal in this thesis would be to extend the navigation work and include Arm manipulation to pick up and place objects.



Requirements:

Good knowledge in programming especially with Python and C++, prior experience with ROS and Gazebo simulator will be preferred, but not compulsory, good communication skills

Benefits:

Access to the Turtlebot3 with OpenManipulator in our lab, use of already developed packages from our previous works, experience with ROS and robotics

References:

[1] Mnih, V., Kavukcuoglu, K., Silver, D., Rusu, A.A., Veness, J., Bellemare, M.G., Graves, A., Riedmiller, M., Fidjeland, A.K., Ostrovski, G. and Petersen, S., 2015. Human-level control through deep reinforcement learning. nature, 518(7540), pp.529-533.

[2] Han, D., Mulyana, B., Stankovic, V. and Cheng, S., 2023. A survey on deep reinforcement learning algorithms for robotic manipulation. Sensors, 23(7), p.3762.

[3] https://emanual.robotis.com/docs/en/platform/turtlebot3/manipulation/

[4] Nath, A., Oveisi, A., Pal, A.K., Nestorović, T., 2024. Exploring Reward Shaping in Discrete and Continuous Action Spaces: A Deep Reinforcement Learning Study on TurtleBot3, PAMM (in review)

Contact
M.Sc. Amit Pal (Room ICFW 03-729)
AG Mechanik adaptiver Systeme
Ruhr-Universität Bochum
Amit.Pal@ruhr-uni-bochum.de

Mechanik adaptiver Systeme
Prof. Dr.-Ing. Tamara Nestorović