TECHNISCHE UNIVERSITÄT MÜNCHEN
Human-centered Assistive Robotics
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M A S T E R ' S T H E S I S
for
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Policy Search for Automatic Polyculture Farming using Reinforcement Learning

Problem description:

Polyculture farming constitutes more complex challenges compared to monoculture farming. Like in many real world applications, there is no perfect simulation available to search for possible cultivation policies in large garden configuration spaces [1]. Furthermore, this environment is only partially observable and is governed by complex, non-stationary dynamics. The research of agents that plan decisions in advance in such environments has been a major task of scientists in the field of artificial intelligence. Recently, progress has been made in deep reinforcement learning (deep RL) that permits finding sub-optimal policies in such environments [2] – especially planning algorithms based on look-ahead search in challenging domains [3], which would permit dealing with the gradual and delayed correlations typical of plant caring scenarios [4]. The aim of this work is to tackle the challenges of polyculture farming by first extending the simulator that was developed in the context of the Alpha-Garden project [5] to enable researching robust cultivation policies with a RL approach that is based on a tree-based look-ahead search for planning with a learned model.

Tasks:

- Literature overview on RL approaches suitable for partial observable environments.
- Implement an RL approach for polyculture farming in the Alphagarden scenario.
- Improve the Alphagarden simulator for a better sim2real transfer.
- Performance evaluation of RL approach compared to existing decision-making strategies.

Bibliography:

[1] Y. Avigal et al. Simulating Polyculture Farming to Tune Automation Policies for Plant Diversity and Precision Irrigation, in *CASE* 2020.
[2] J. Schulman et al. Proximal policy optimization algorithms, in *arXiv preprint:1707.06347* 2017.
[3] D. Silver et al. Mastering the game of Go with deep NNs and tree search, in *Nature* 2016.
[4] A. Agostini et al. A cognitive architecture for automatic gardening, in *Computers and Electronics in Agriculture*. 2017.
[5] K. Goldberg et al. AlphaGarden, *[Online]. Available: http://rapid.berkeley.edu.*.

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