TECHNISCHE UNIVERSITÄT MÜNCHEN
Human-centered Assistive Robotics
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F O R S C H U N G S P R A X I S
for
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An Experimental Comparison of Model-based Reinforcement Learning Approaches

Problem description:

Reinforcement learning (RL), or leaning by self-practice, is an appealing approach widely used in robotics to learn complex skills. However, applying RL algorithms to robotics and control problems usually requires several rollouts on real devices, which is tedious and time consuming. Model-based RL approaches offer a possible solution. The Probabilistic Inference for Learning Control (PILCO) [1] explicitly considers inaccuracies in the policy search and requires few rollouts to find an optimal policy. A limitation of PILCO is that it requries long training time even for relatively simple tasks [6]. In order to reduce the training time, authors propose to exploit expert domain knowledge by providing, a priori, an approximate robot model. In [3, 5], an optimal control approach—the Iterative Linear Quadratic Gaussian (ILQG) approach [2]—is used to find a control policy for the approximate model, and RL to search for a control policy for the real robot. In [4, 6], the prior model is incrementally refined with real data to build an accurate representation of the robot dynamics and find an optimal policy. In this Forschungspraxis work the student has to implement the state-of-the-art RL algorithm in [3]. The implemented approach will be tested and compared with [1] and [6] on a simulated benchmark.

Work schedule:

- Literature review of reinforcement learning algorithms.
- Implementation of the approach in [3].
- Comparison with the approaches in [1] and [6].

Bibliography:

[1] Deisenroth et al., "Gaussian Processes for Data-Efficient Learning in Robotics and Control", in *TPAMI*, 2015.
[2] Tassa et al., "Control-Limited Differential Dynamic Programming", in *ICRA*, 2014.
[3] Levine et al., "Control-Limited Differential Dynamic Programming", in *NIPS*, 2014.
[4] Cutler et al., "Efficient reinforcement learning for robots using informative simulated priors", in *ICRA*, 2015.
[5] Farshidian et al., " Learning of Closed-Loop Motion Control", in *IROS*, 2014.
[6] Saveriano et al., " Data-Efficient Control Policy Search using Residual Dynamics Learning", in *IROS*, 2017.

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