TECHNISCHE UNIVERSITÄT MÜNCHEN
Human-centered Assistive Robotics
UNIV.-PROF. DR.-ING. DONGHEUI LEE

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MASTER'S THESIS
for
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Blending Task and Motion Planning through Learning from Demonstration and Reinforcement Learning

Problem description:

Task and motion planning (TAMP) architectures [1] combine the efficiency of symbolic planning methods to quickly generate task plans [3] with motion planning mechanisms to ground symbolic actions [4]. Most of the TAMP frameworks bring together these two planning paradigms through geometric reasoning methods that search for suitable acting parameters to execute symbolic actions [1, 2]. However, this strategy requires intensive computation and several calls to motion planning on unfeasible actions to search for solutions in the large object configuration space. This work tackles these limitations by associating to symbolic actions action policies that permit defining acting parameters reactively for each particular object configuration, without the need of deliberation. These policies are learned in a combined strategy that, on the one hand, generates a set of dynamic movement primitive (DMP) parameters from demonstration of symbolic actions [4]. On the other hand, it generates an action policy using a reinforcement learning (RL) approach based on policy improvement with path integrals [5] to generalize these parameters for action execution in unforeseen situations.

Tasks:

- Literature overview on TAMP, learning from demonstration (LfD), and policy-based RL.
- Implement an RL approach for the execution of symbolic actions using LfD as guided exploration.
- Integrate the RL approach into a TAMP framework.
- Experimental evaluation of scalability and transferability of the TAMP framework using RL.

Bibliography:

[1] J. Bidot et al. Geometric backtracking for combined task and motion planning in robotic systems, in *Artificial Intelligence Journal* 2017.
[2] N. Dantam et al. An incremental constraint-based framework for task and motion planning, in *The International Journal of Robotics Research*. 2018.
[3] M. Ghallab et al. Automated Planning: theory and practice, *Elsevier*. 2004.
[4] A. Ijspeert et al. Dynamical movement primitives: learning attractor models for motor behaviors, in *Neural computation*. 2013.
[5] M. Deisenroth et al. A survey on policy search for robotics, in *Found. and Trends in Rob.*. 2013.

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