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B A C H E L O R   T H E S I S

Task Parameterized-Dynamic Movement Primitives adaptation using reinforcement learning.

Problem description:

Dynamic Movement Primitive (DMP) provides a way for encoding motion data [1]. DMP model consists of two dynamical systems with one way parameterized connection such that one system drives the other (acting as a clock). Dynamical system can either form point attractor or limit cycles which make them suitable for imitating single-stroke movements or rhythmic tasks and provide robustness against perturbation. The approach relies on reshaping the attractor landscape by using non-linear regression for imitating demonstrated movement. The original formulation of DMP has the limitation of learning single demonstration at a time. Parametric-DMP (PDMP) provides an approach of learning multiple demonstrations at a time [2]. PDMP has the set of style parameters which can be used for reproducing different motions.
This thesis will consider Task Parameterized-DMP (TP-DMP) for encoding multiple demonstrations using Gaussian Mixture Models (unpublished). TP-DMP provides interpolation as well as extrapolation capabilities of the demonstrated task and can learn from very few demonstrations. The goal of this work is to investigate how to improve the performance of learned TP-DMP model by entracting with the environment, by utilizing reinforcement learning [3] and model refinement approaches. The student will be provided with existing Matlab and C++ codes for TP-DMP and is expected to perform experiments using KUKA-LWR.

Tasks:

- Reviewing the relevant literature.
- Testing model refinement and reinforcement learning approaches for improving the TP-DMP performance.
- Validating the model improvement with simulated as well as real robot experiments.

Bibliography:

[1] Ijspeert, Auke Jan, Jun Nakanishi, and Stefan Schaal. Learning attractor landscapes for learning motor primitives. No. BIOROB-CONF-2002-004. 2002.
[2] Matsubara, Takamitsu, Sang-Ho Hyon, and Jun Morimoto. "Learning parametric dynamic movement primitives from multiple demonstrations." Neural Networks 24.5 (2011): 493-500.
[3] Kober, Jens, J. Andrew Bagnell, and Jan Peters. "Reinforcement learning in robotics: A survey." The International Journal of Robotics Research (2013): 0278364913495721.

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