TECHNISCHE UNIVERSITÄT MÜNCHEN
Human-centered Assistive Robotics
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01.01.2017

M A S T E R T H E S I S
for
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Deep-Dynamic Movement Primitives learning with Convolutional Neural Networks.

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 (forcing terms) for imitating demonstrated movement.
The forcing terms of a DMP can be modeled with the radial basis functions [1] or any other suitable function approximator [2]. Recently deep learning approaches using the Convolutional Neutral Networks (CNN) have provided promising results in robotics applications [3]. This work will focus on replacing the forcing terms of a DMP with a Convolutional Neural Networks (CNN) [4]. This in turn can provide more informative input to a DMP, by directly processing the camera images with a CNN.

Tasks:

- Reviewing the relevant literature.
- Testing different CNN architectures for improving the TP-DMP performance.
- Validating the performance improvement with 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] Affan Pervez, Dongheui Lee. "Learning Task Parameterized Dynamic Movement Primitives using mixture of GMMs"
[3] Levine, Sergey, et al. "Learning Hand-Eye Coordination for Robotic Grasping with Deep Learning and Large-Scale Data Collection." arXiv preprint arXiv:1603.02199 (2016).
[4] Krizhevsky, Alex, Ilya Sutskever, and Geoffrey E. Hinton. "Imagenet classification with deep convolutional neural networks." Advances in neural information processing systems. 2012.

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Start:	01.01.2017
Intermediate Report:	19.05.2017
Delivery:	21.07.2017

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