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

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M A S T E R ' S T H E S I S
for
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Task-Constrained Optimization of Multiple Demonstrations using Gaussian Mixture Models

Problem description:

In the context of programming by demonstration, Gaussian mixture models have the advantage of being able to explicitly represent the variance in multiple demonstrations for the same task [4]. Recently, GMMs have been extended so that they are able to adapt to different variations of a task [1]. In another line of research, model-free reinforcement learning and black-box optimization have been used to optimize robotic policies represented by, for instance, dynamical movement primitives [2] or probabilistic movement primitives [3]. The aim of this Thesis is to apply black-box optimization to (task-parameterized) Gaussian mixture Models. The novelty of the project is to analyze the variance in the set of multiple demonstrations in order to determine task constraints which should not violated during optimization. The parameters of the Gaussians, which are not constrained, are optimized, i.e. to minimize the quadratic command cost along the trajectory.

Tasks:

- Understand task-parameterized Gaussian mixture models (TP-GMM) and their implementation
- Understand black-box optimization of robotic policies and trajectories
- Apply black-box optimization to TP-GMMs for a toy task in Matlab
- Conduct experiments on a KUKA LBR 4+ (Matlab Simulink)
- Write a conference paper (ICRA'18) and Maser's thesis

Supervisor:	Univ.-Prof. Dr.-Ing Donheui Lee
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Bibliography:

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[4] A. Billard S. Calinon, F.Guenter. On learning, representing and generalizing a task in a humanoid robot. *IEEE Transactions on Systems, Man and Cybernetics, Part B. Special issue on robot learning by observation, demonstration and imitation*, 37:26 –28, 207.