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LEHRSTUHL FÜR STEUERUNGS- UND REGELUNGSTECHNIK

UNIV.-PROF. DONGHEUI LEE

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M A S T E R ' S   T H E S I S
for
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Student ID , Degree

Learning Dexterous Manipulation Skills for a Low-Cost Prosthetic Hand

Problem description:

The objective of this thesis is to develop a reinforcement learning algorithm that provides a low-cost robotic hand [1] with dexterous manipulation capabilities. A hand with dexterous manipulation capabilities is able to change position and orientation of a grasped object only exploiting finger movements and without moving the palm. Within the robotic community, learning in-hand manipulation skills is still a novel and not fully explored problem. A first, recent paper that deals with learning in-hand manipulation is [4]. In [4], a dual-finger robotic hand moves an object located on a table from an initial position to the goal position. In this work, an Open Bionic prosthetic hand will be equipped with low-cost tactile sensors. Differently from [4], the task will consist in holding and rotating the object with the fingers without any support surface. While classical methods based on planning perform well when environment and object models are known [2], approaches based on reinforcement learning algorithms such as [3] have the potential to shine in presence of unknown objects and inaccurate hand models. In more detail, the orientation of an object held in the robotic hand will be controlled while avoiding slippage and exploiting both visual and tactile perception.

Tasks:

- Research the literature concerning in-hand manipulation
- Assembly the Open Bionic Hand
- Mount low-cost tactile sensors on the fingertips
- Implement a model-based reinforcement learning algorithm to fulfill a in-hand manipulation task

Supervisor:	Pietro Falco
Start:	XX.XX.2015
Intermediate Report:	XX.XX.2015
Delivery:	XX.XX.2015

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Bibliography:

[1] Open Bionic Hand. http://www.openbionics.com/shop/. [Online; accessed 19-May-2016].
[2] Moez Cherif and Kamal K Gupta. Planning quasi-static fingertip manipulations for reconfiguring objects. *Robotics and Automation, IEEE Transactions on*, 15(5).
[3] Marc Deisenroth and Carl E Rasmussen. Pilco: A model-based and data-efficient approach to policy search. In *Proceedings of the 28th International Conference on machine learning (ICML-11)*.
[4] Herke van Hoof, Tucker Hermans, Gerhard Neumann, and Jan Peters. Learning robot in-hand manipulation with tactile features. In *Humanoid*, pages 121–127. IEEE, 2015.