

1. 4. 2017

MASTER'S THESIS
for
Daniel Bargmann
Student ID 03610077, Degree EE

Evaluation of machine-learning-based approaches to load estimation based on sEMG and inertial signals during lifting movements of the upper body

Problem description:

In a previous project at Fraunhofer IPA, a power orthosis has been established, which is aimed to support a user when lifting heavy objects as well as reducing strains on a healthy user's upper- and underarm. [1] [2]

The orthosis has been developed with two control modes in mind - one for support and one for transparent mode.

In order to evaluate the level of required support by the orthosis, surface Electromyography (sEMG) should be used in conjunction with various machine learning algorithms. [3]

In this work the student has to research the state-of-the-art of surface EMG and its application to load and user intent detection.

Furthermore current applications of machine learning algorithms in the field of neural signal processing, especially surface EMG have to be evaluated.

After that the student has to establish a connection from a professional wireless surface EMG to a PC. As a final step, the student has to estimate the level of support required with various machine learning algorithms.

Tasks:

- Literature analysis: sEMG, machine learning, user intention and load recognition with EMG
- Establishing a connection from EMG to PC
- Implement an estimation algorithm for user load
- Evaluating its performance

Bibliography:

- [1] ICON Project <https://www.fraunhofer.de/de/presse/presseinformationen/2015/Dezember/fraunhofer-und-universitaet-auckland-kooperieren.html>
- [2] Pratt, G.A. and Williamson, M.M. Series elastic actuators *Proceedings 1995 IEEE/RSJ International Conference on Intelligent Robots and Systems. Human Robot Interaction and Cooperative Robots*
- [3] M. Sartori, D. G. Lloyd and D. Farina, Neural Data-Driven Musculoskeletal Modeling for Personalized Neurorehabilitation Technologies, *IEEE Transactions on Biomedical Engineering*, vol. 63, no. 5, pp. 879-893, May 2016.

Supervisor: Matteo Saveriano (TUM), Christophe Maufroy, PhD (Fraunhofer IPA)
Start: 1.4.2017
Intermediate Report: XX.XX.2017
Delivery: XX.XX.2017

(D. Lee)