From NinaPro to MeganePro towards the natural control of myoelectric prosthetic hands

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Abstract

The loss of an upper limb strongly affects capabilities and quality of life of a person. Dexterous robotic hand prostheses controlled by surface electromyography (sEMG) can significantly improve the condition of hand amputees. However, despite the excellent mechanical capability of the devices and a usually long training period, their control is currently limited and often not natural. Remarkable improvements in myoelectric prosthetic control were reached applying machine learning and pattern recognition techniques. In 2014, the NinaPro project released the biggest publicly available database of hand movement sEMG, kinematic and dynamic data. The aim is to improve the myoelectric hand prosthetic control by creating a benchmark database, so worldwide research groups can develop, test and compare solutions. The NinaPro database contains data of several repetitions of 50 different hand movements (including grasps), recorded from 67 intact and 11 transradially amputated subjects. The set of movements is based on the existing literature and the acquisition protocol is easily reproducible. The stump muscle activity, wrist inclination as well as kinematics and dynamics of the hand were measured. Several signal features and classification methods were used to perform movement classification using the data. The results encourage the use of NinaPro data and machine learning methods to increase naturalness and robustness of myoelectric control. Nevertheless, the improvement achievable with only sEMG information seems insufficient for reaching a fully natural control for all needs in daily life. High classification accuracy was obtained adding accelerometer information. This is consistent with recent studies: movement classification can be increased using additional sources of information. An increased recognition rate was also observed in subjects experiencing vivid phantom limb sensation. The MeganePro project aims at improving the robotic prosthetic hand control by adding gaze tracking and object recognition as additional methods and by working on current knowledge of neurocognitive amputation aspects.

References

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Short Biography

Cognolato Matteo was born in Padova (Italy) in 1989. In 2008 he finished a bachelor in computer science at the ITIS Francesco Severi, then studied Biomedical Engineering and Bioengineering at the University of Padova, achieving a master degree in 2015. Since January 2016 he has been working at the HES-SO Valais-Wallis on the MeganePro project in the eHealth unit coordinated by Prof. Henning Müller.

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