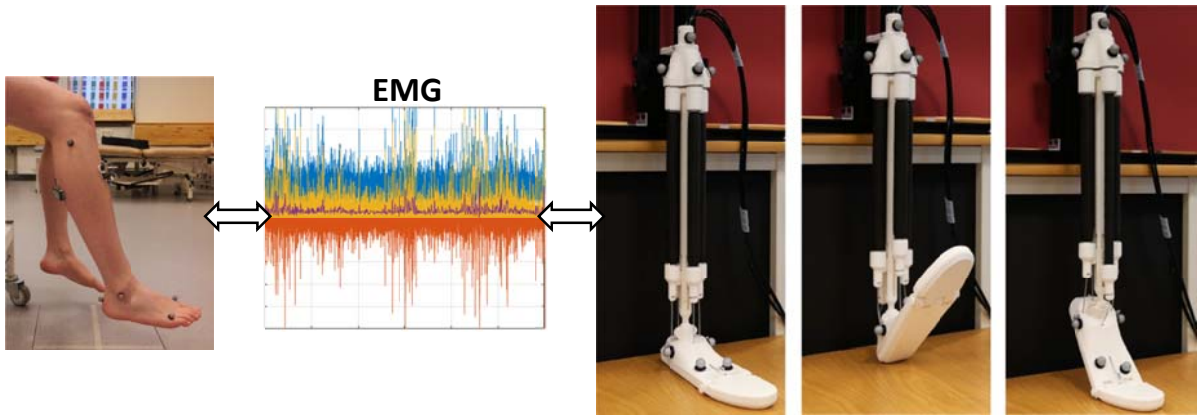
Electromyography (EMG) based Control of a Humanoid Robotic Leg

Master Thesis Proposal in Automatic Control



Proposed research vision for the motion control of the HURL setup **[1]** (right)

The HUmanoid Robotic Leg (HURL) **[2]**, currently being under development in the Field Robotics Laboratory, is actuated via pneumatic artificial muscles and possesses the mechanical ability of reproducing the 2 Degree of Freedom (DoF) movement capabilities of the human ankle: a) dorsiflexion/plantar flexion, and b) inversion/eversion. Such a robotic appliance is considered as the initial conceptual point and mandatory infrastructure for enabling future interactive applications on lower-limb balance research driven by smooth, fast and accurate movements.

This master thesis will address the need for human-based teleoperation and control of the HURL, where the participant will undertake the incorporation and use of Electromyographic (EMG) sensors as a means of extracting the user's intention of movement. In this way, the acquired EMG signals from the user's leg will act as 2-D reference signals for the HURL, where a controller will have to be implemented for the reproduction of these movements in a robust and adaptive manner.

The EMG-based motion control of the HURL will enable further research on the synthesis and evaluation of balancing and gait algorithms, for its potential use as an active prosthetic limb.

Measurements regarding the motion angles of the HURL and EMGs from the user's muscles will be acquired via the testing of various sensors (IMUs, VICON, EMG boards etc.).

- No. of Participants: 1 Student
- The development of the HURL's EMG-based control system will require the handling of various mechanical and electronic components (pressure regulators, I/O Cards, microprocessors, sensors etc.)
- The programming of the HURL's EMG-based control system will require the use of various software packages (Matlab, ROS, LabVIEW) and various of operating systems (Windows, Linux, Arduino etc.)
- Knowledge in computer-aided-design (CAD) and Rapid Prototyping (3D Printing) will be considered a plus.
- Guidance will be provided by the supervisors on a weekly discussion basis.

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References

[1] U. Mamikoglu, G. Andrikopoulos, G. Nikolakopoulos, U. Röijezon, M. Pauelsen, and T. Gustafsson, "Electromyography Based Joint Angle Estimation and Control of a Robotic Leg", in *6th IEEE RAS EMBS International Conference on Biomedical Robotics and Biomechatronics* (BIOROB), 26 – 29 June 2016, UTown, Singapore.

[2] G. Andrikopoulos, G. Nikolakopoulos, "On the Design, Development and Motion Control of a Humanoid Robotic Leg via Pneumatic Artificial Muscles", in *IEEE International Conference on Robotics and Biomimetics* (ROBIO), 3 – 7 December 2016, Qingdao, China.