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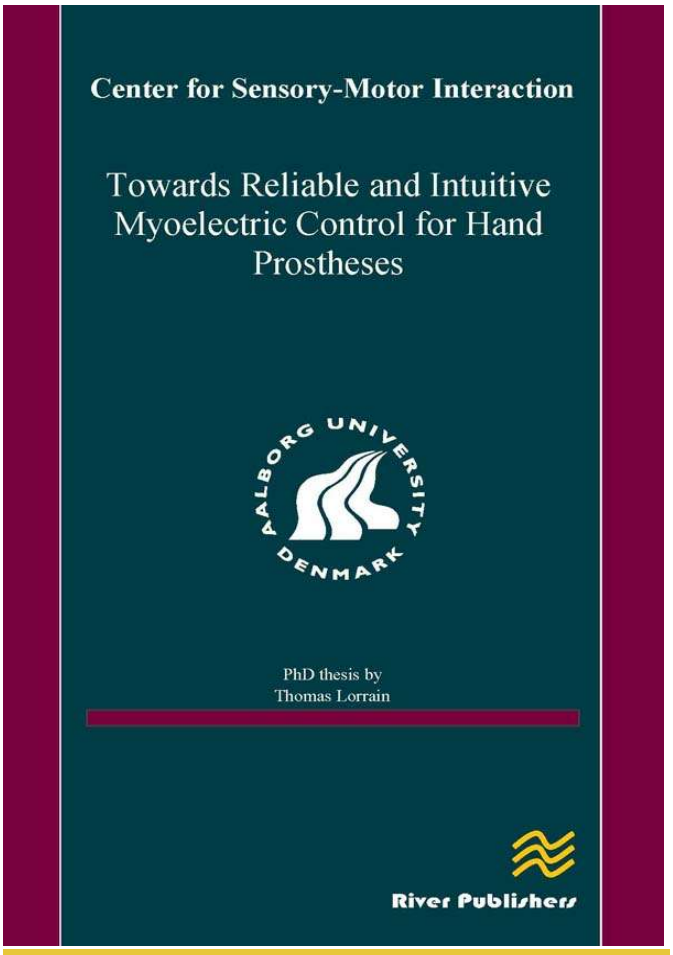
Towards Reliable and Intuitive Myoelectric Control for Hand Prostheses

Author: Thomas Lorrain, Department of Health Science and Technology, Aalborg University, Denmark

The loss of a hand implies loss of motor functions and potential psychological disturbance of self-image. In order to restore some of the lost functions and help patients to overcome their trauma, great research efforts have been spent on the development of hand replacement prostheses. Despite these efforts, electrically powered prostheses available to patients remain of unnatural use and very limited dexterity, due to the limitations of the control methods available. Myoelectric control has been shown as an efficient way to control powered prostheses, however intuitive and reliable control of multiple degrees of freedom remains to be achieved.

The aim of this PhD thesis is to investigate the limitations of current myoelectric control strategies and provide alternative solutions towards a more functional control method. In order to achieve this goal, the project was divided in three studies. In the first study, current myoelectric control systems showed to be able to operate on dynamic situations with satisfying performance, but at the cost of training requirements to maintain reliability. Based on these results, an alternative control system using a state-based approach was developed to overcome some of these limitations. In study 2, the proposed system showed promising offline performance and high reliability compared to a traditional myoelectric control system. Then the system was further improved by including proportional control, and its online performance was investigated in study 3 with virtual feedback. The results showed that the proposed system allowed precise target reaching and force control during grasp, with very short training. In conclusion, this PhD project investigated the limitations of available myoelectric control systems, and developed an alternative control system to overcome these limitations. The proposed system showed promising performance during both offline and online analyses, and could have the potential to provide myoelectric users with a more intuitive, yet reliable control system.



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