Error Amplification Control with Weight Compensation for Robotic Neurorehabilitation

Background:

Many stroke survivors experience reduced arm function and weakness due to paresis. In chronic stroke patients, abnormal synergies -i.e., loss of independent joint control- limit patients' movement workspace. In order to address these limitations, different arm weight compensation methods have been implemented and are in use with exoskeleton robots in rehabilitation. Challenge-based training strategies -i.e., robotic strategies that augment errors rather than reduce them- have also been proposed as promising training strategies to enhance neurorehabilitation outcomes. However, if patients cannot bare the weight of their own arm, it becomes hard to use novel robotic training controllers that challenge the movement, such as error amplification.

This project focuses on combining the weight compensation methods and error amplification controllers on the ARMin exoskeleton robot in order to take advantage of both strategies. Different weight compensation methods have already been implemented on ARMin. However, these do not consider the configurational dependent effects of the human arm, which affects the accuracy of the weight compensation. Within this thesis, your first task will be to improve the weight compensation methods employing modelling techniques. An activity of daily living task (e.g. watering plants) will be implemented in Unity, which will be then integrated to ARMin with haptics. Error amplification, weight compensation and haptic guidance will be implemented on this task. Comparison of controllers; only weight compensation, weight compensation with error amplification and only haptic guidance, will be performed with subjects (healthy or stroke subjects) in a study.

Outline:

1. Literature research: The effects of conventional controllers in rehabilitation.
2. Weight compensation: Improvement of the method.
3. Implementation: The task in Unity, controllers in ARMin.
4. Study: A study with real subjects to test/compare the effect of controllers.
5. Scientific reporting: Scientific reporting of the methods and results.

Materials and Methods:
Virtual game environment (Unity3D), haptics for the robot (C++).
Requirements:
Basic programming skills.
Supervisor:
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Institutes:
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