Chair of Ergonomy
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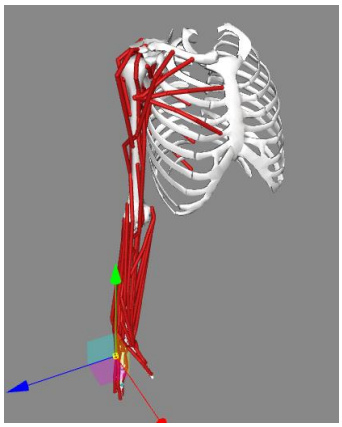
Modeling of the muscletendon kinematic of the shoulder for implementation in EMG-driven exoskeleton control

Semester Thesis / Master's Thesis

Key words: exosuit, exoskeleton, simulation, biomechanics, modelling, muscles, control, EMG

Background



The upper limb plays an important role in the activities of daily living. A large number of musculoskeletal and neurological disorders can reduce the upper limb function and thus the quality of life of the person concerned. This type of disorders can occur after Stroke, severe rotator cuff tear, Spinal Cord Injury, or after breast cancer.

Soft exoskeletal assistive devices represent a promising solution to assist people with upper extremity impairments in the rehabilitation process outside the clinic or rehabilitation center.

Current solutions have deficiencies especially in human-centered, intention-based control, which currently prevents wider application. EMG-driven model based control strategies can help to overcome current drawbacks.

However, such a control strategy is associated with considerable challenges: Multiple muscle-tendon units (MTUs) are spanning a joint in the human body, representing a highly redundant neuromuscular actuation system. For coordinated excitation the neuronal system of the human body uses complex MTU excitation strategies to create joint moments and motion. Thus, muscle excitation patterns must be interpreted correctly in order to realize a EMG-driven intention based control. Musculoskeletal models can help to assign the EMG signals to a certain movement intention.

A step towards such a control strategy is the development of a model describing the kinematic of MTUs.

The goal of this study is to create MTU-specific multidimensional spline functions to produce instantaneous estimates of MTU length, and three-dimensional moment arms as a function of joint angles.

Tasks

- Setup of a matlab script to parametrize, and control a musculoskeletal model of the shoulder joint.
- Simulation and analysis of a large number of arm motions by use of a musculoskeletal model.
- Deriving multidimensional spline functions describing the muscletendon kinemamtics of the shoulder joint.
- Programming of a script for visualization of the created spline functions.
- Documentation and reporting.

Requirements

- Basic understanding of the human musculoskeletal system
- Experience in programming and/or simulation
- Strong interest in biomechanics, control and soft robotics

Contact

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