Development of a muscle wrapping model of the human hand for musculoskeletal dynamics simulations

master's thesis

Obtaining the correct muscle-tendon paths efficiently is a crucial requirement to conduct musculoskeletal simulations. These muscle paths are often modelled as shortest paths of taut massless strings that glide frictionless over so-called wrapping surfaces (defined by bones or underlying muscles). This can be realized utilizing a model based on geodesics, locally shortest paths [1,2].

Figure 1: Hand with reflective markers for motion capturing (left), dynamic torque driven hand model (middle), and intrinsic muscles of the hand (right, Wikipedia).

The aim of this thesis is to develop a musculoskeletal model of the hand based on a geodesic muscle path model that can be formulated in a monolithic way with the musculoskeletal dynamics of the whole system, based on [1]. The thesis is supervised by researchers at LTD and associated to the CRC 1483 EmpkinS where novel methods for non-invasive and objective estimation for diseases monitoring are being investigated. A continuation as doctoral researcher after the thesis is desirable.

Necessary qualifications

- fluent in English or German
- good knowledge of multibody dynamics & engineering mathematics
- good programming skills (Matlab, Python, or similar)
- interest in simulation or biomechanics

If you are interested send an email to:
M. Sc. Simon Heinrich
simon96.heinrich@fau.de

Start date: as soon as possible

[1] J. Penner, S. Leyendecker *et al.*, "A Discrete Mechanics Approach for Musculoskeletal Simulations with Muscle Wrapping", *Multibody System Dynamics*, vol. 56, no. 3, 267–287, 2022, DOI: 10.1007/s11044-022-09844-x
[2] A. Scholz *et al.*, "A Fast Multi-Obstacle Muscle Wrapping Method Using Natural Geodesic Variations", *Multibody System Dynamics*, vol. 36, no. 2, 195–219, 2016, DOI: 10.1007/s11044-015-9451-1