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Tendon-pulley friction mechanism development

Project type: BSc/MSc Thesis, Collaboration

Description

Most robotic and prosthetic tendon-driven hands to date employ a transmission mechanism that aims towards a frictionless transmission. In the human tendon-sheath mechanisms however, frictional forces might be beneficial. However, it has been experimentally shown that during high load flexion of the interphalangeal joints, eccentric and concentric forces differ by 9%, a difference that can be directly accounted to tendon-sheath friction [1]. Utilizing a friction mechanism in robotic hands can have two alternative advantages: force output of a frictionless system can, with a frictional system in place, (1) be increased at no additional motor-loading cost or (2) achieved using lower torque motors, thus saving both weight and energy.

Tasks

Your task will consist of using an existing two-link model of a tendon-driven system [2] to identify parameters optimal towards friction contribution in the force output system of the motor. You can then either (1) proceed towards increasing the complexity of the model or (2) design and create appropriate mechanisms that reproduce this frictional effect for use in a tendon-driven prosthetic hand. For (1), possible examples include increasing the number of joints, modelling bi-articulation, "elasticizing" the tendons and so on. For (2), the design tasks required range from selecting appropriate materials to mechanical systems that maximize friction under certain conditions.

Applicant

The applicant should be a mechanical engineering student/graduate, with a good background in Matlab, CAD software (Solidworks preferred) and tribology, with an interest in robotic/prosthetic applications. The thesis is to be written in English.

References

[1] Schweizer, A., Frank, O., Ochsner, P., & Jacob, H. (2003). Friction between human finger flexor tendons and pulleys at high loads. Journal of biomechanics, 36, 63-71.
[2] Dermitzakis, Konstantinos and Morales, Marco Roberto and Schweizer, Andreas, Modeling the Frictional Interaction in the Tendon-Pulley System of the Human Finger for Use in Robotics. Artificial Life.

Supervisor

Your contact for this project is Konstantinos Dermitzakis from the AI Lab Zurich (http://ailab.ch/dermitza). You can best reach him by email (dermitza@ifi.uzh.ch).