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Robot thumb kinematic model optimization

Project type: BSc/MSc Thesis, Collaboration

Description

The last few years have seen an explosion of research in the area of dextrous manipulation for humanoid and prosthetics applications. However, there has not been a considerable volume of research in terms of optimizing the morphology and degrees of freedom (DOFs) of thumbs of robotic hands. We hypothesize that by optimizing these parameters, it could be possible to increase the ratio of DOF/active DOF required while maintaining grasp, dexterity and range of motion similar to these of a human hand. In order to prove our hypothesis, we will need to optimize kinematic models of robot thumbs by identifying and using appropriate optimization criteria against models of the human thumb.

Tasks

You will be given a framework that automatically generates randomized kinematic models of robotic thumbs, created using the Robotics Toolbox for MATLAB. Your task will consist of extending the framework with an optimization technique (up for discussion) that selects candidate models based on a particular performance metric. This metric will be based on existing kinematic models of the human thumb.

Applicant

The applicant should be a Computer Science, Mechanical Engineering or Biology student or graduate, with good background in Matlab (C++/Java also good to know), and an interest in robotic/prosthetic applications. The thesis is to be written in English.

References

[1] Kuczynski, K. (1974). Carpometacarpal joint of the human thumb. *Journal of anatomy*, *118*(Pt 1), 119-26.
[2] Hollister, A., Buford, W., Myers, L., Giurintano, D., & Novick, A. (2005). The axes of rotation of the thumb carpometacarpal joint. *Journal of Orthopaedic Research*, *10*(3), 454–460. John Wiley \& Sons.
[3] Hollister, A., Giurintano, D., Buford, W., Myers, L., & Novick, A. (1995). The axes of rotation of the thumb interphalangeal and metacarpophalangeal joints. *Clinical orthopaedics and related research*, *320*, 188–193.
[4] Santos, V., & Valero-Cuevas, F. (2006). Reported anatomical variability naturally leads to multimodal distributions of Denavit-Hartenberg parameters for the human thumb. *IEEE Transactions on Biomedical Engineering*, *53*(2), 155–163.

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).