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LINEAR IDENTIFICATION PROCEDURE TO OBTAIN A LOW COMPUTATIONAL COST MODEL FOR HAND GRASPING IN ANTHROPOMORPHIC HANDS

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Summary: Human hand grasping is a very complex process that has been studied for years under different perspectives [1]. In the field of prosthetics, artificial hands have to accurately emulate human grasping at the lowest possible cost. Currently, control algorithms tends to program in on-board commercial microcontrollers, preventing the design of high performance systems. Mechanical models based on physical equations, such as Lagrange equations, provide accuracy and allow the design of high performance control systems, requiring high computational effort when discretized.
Linear models are widely known in the literature [2] as their computational effort is low. Linear algorithms are easy to program and can be used in real-time. However, they lose the physical meaning of the system and sometimes the valid range of use is not wide enough. Many times, the identification procedure and algorithms need high quality data to obtain a valid model.
In this paper we present a first step to obtain a control model for the BRUJA hand, a 5-finger 6 DoF low-cost prosthetic hand developed by the R&D group (an improved version of our Devalhand hand [3]). In this work, we focus on the index finger in order to define: a) a videogrammetric test to obtain high quality data for identification purposes; b) a linear model structure that fits the dynamics equations and c) a linear model and a valid range of use for the index finger. We have defined a test to sufficiently excite the system to get valuable data. We have studied different identification algorithms. The model structure is fit considering the system physical characteristics. Finally, linear models have been developed to design low computational effort control algorithms for anthropomorphic hand prosthesis.

References

[1] Sancho-Bru J.L. et al. (2011), Towards a Realistic and Self-Contained Biomechanical Model of the Hand, Theoretical Biomechanics, InTech Ed.
[2] Zhu Y. and Backx T. Identification of Multivariable Industrial Processes for simulation, diagnosis and control. Springer-Verlag (1993).
[3] Rubert C. and A. Morales (2016). "Comparison between grasp quality metrics and the anthropomorphism index for the evaluation of artificial hands". 6th IEEE RAS/EMBS International Conference on Biomedical Robotics and Biomechatronics.