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Title: Hydraulic integration technology for lower limb active prosthetics

A.Abdellatif,

Mechatronics Department, College of Engineering, Arab Academy for Science and Technology and Maritime Transport (AASTMT), Cairo, Egypt,

Abstract

Prosthetic devices are nowadays one of the most important branches of bio-robotics. The goal of giving back to amputees the possibility to carry out daily activities on their own represents a fascinating challenge for both medical and engineering researchers alike. A lower prosthetic device replaces a lost lower human body part and acts as a real lower limb replacement for. people with lower extremity amputation. One of the important research points is the actuation of prosthetics. Hydraulic actuation normally ensures high power to weight ratio, absence of mechanical couplings between the motor and the load, steady intermitted torques, high force controllability, shock and vibration absorption, the ability to adapt in uneven locomotion environments in addition to the possibility to apply compliance at its end effector. However, the usage of hydraulics requires a hydraulic power pack for torque generation in addition to cumbersome heavy hydraulic piping for power transmission.

A new technology is discussed in this research, in which hydraulic integrated pathways are machined in the mechanism body parts to ensure the passage of hydraulic fluid to actuators, more like blood in human arteries. In this way, weight optimization, and faster dynamic responses are gained for the prothesis in addition to minimum external hydraulic leakage. More optimization is gained through combining the hydraulic actuators with lightweight materials, for example, carbon-fiber-reinforced plastic (CFRP), so that maximum high load-to-weight ratio is achieved. An integrated hydraulic prosthetic device is introduced and controlled. In this prototype, the design parameters, material, friction parameters and leakage parameters are observed, analyzed and discussed.

Recent Publications

1. A.Abdellatif , S.Hallak and S.Alfayad , “Development of an on-board power pack for the hydraulic humanoid robot HYDROïD”, International Review of Mechanical Engineering (I.RE.M.E.) , Vol.12, ISSN.08, pages 726-733, November 2018..
2. A.Abdellatif, Tan Quang DUONG, S.ALFAYAD, Olivier BRUNEAU “Force control for electro-hydraulic servo actuator used for a humanoid robotic arm ” International Journal of Mechanical & Mechatronics Engineering IJMME / IJENS,173106-1805-5454-IJMME-IJENS, Vol.18, Issn.05, October 2018.
3. A.Abdellatif, S.Alfayad, Arne-Christoph Hildebrandt, F.B. Ouezdou, N.Mechbal, Yahya Zweiri, “Development of a new hybrid ankle mechanism for humanoid robot HYDROïD” Journal of Intelligent & Robotic Systems, issn=1573-0409, doi=10.1007/s10846-017-0750-z, March 2018.
4. A. Abdellatif, Samer Alfayad, Fethi B. Ouezdou, Salem A. Haggag, Faycal Namoun , “Mathematical Modeling of an Electro-Hydraulic Actuator for Humanoid Robots ” ,WSEAS Transactions on Circuits and Systems, ISSN / E-ISSN: 1109-2734 / 2224-266X, Volume 16, 2017, Art. #22, pp. 187-195.



Biography (150 word limit)

Ahmed Abdellatif Hamed IBRAHIM obtained his B.Sc. and MSc. in Mechanical Engineering (Mechatronics) from AAST Alexandria in 2008 and 2012 respectively. He was awarded his Ph.D in the control of humanoid robots from Paris-Saclay university (France) in 2018. Since this date till now, he has been an assistant lecturer in Arab Academy for Science and Technology and Maritime Transport, Egypt. His teaching experience includes Mechatronic systems, Bio-mechatronics, Electro-mechanical systems, Robotics and Hydraulic systems.

Name:Ahmed Abdellatif Hamed IBRAHIM
Email: a_abdellatif@hotmail.com
Phone Number: +201224906513

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