SETSCI Conference Proceedings,
4 (1): 17-17, 2019

ISAS 2019
3rd International Symposium on Innovative Approaches in Scientific Studies

Design and Development of a Hand Exoskeleton Robotic System

Jamshed Iqbal

University of Jeddah, Saudi Arabia

Abstract

Hand exoskeleton systems extend the mechanical sensing and manipulation capabilities of a human user in a real and/or virtual environment. Design of such a system needs careful consideration of associated requirements along with optimised, human-hand compatible and portable mechatronics that should have the ability to exert bi-directional forces. This research presents the design requirements and the development of a kinesthetic force feedback hand exoskeleton system. The selection of actuators have been emerged as a result of experiments with humans of different hand-sizes. Using commercial data glove, load cell and force sensors, various hand parameters e.g. range of motion, maximum and average force levels have been measured.

Mapping the results of these experiments directly to the mechanical design, two portable, direct-driven, optimised, underactuated hand exoskeleton systems having 4 DOF/finger have been proposed. These have been designed for comfort, easy removal and donning and are mountable on the dorsal side of the wearer's hand thus letting the palm free for interaction with the objects.

The Hand EXOskeleton SYStem (HEXOSYS)-I is aimed at providing the maximum force levels exerted by a human hand. The multi-parametric optimisation procedure considering the isotropy, dexterity and exertion of perpendicular forces on the finger phalanges guided the device design. It provides force feedback to the thumb and index fingers.

In an attempt to make the system more realistic and potentially more useful, the average force levels have been targeted in the HEXOSYS-II. To find an optimum mechanism for the exoskeleton, various design concepts have been studied and analysed prior to its design. The optimisation criteria is based on the exoskeleton-finger workspaces matching, worst case collision avoidance and kinematics. It provides force feedback to the thumb, index, middle and ring fingers and supports variable hand sizes.

Finally the prototype of the proposed hand exoskeleton system has been realised with the mechanical components using CAD tools. The HEXOSYS-II with its four fingers prototype has good potential to be used in various applications including haptics, rehabilitation, virtual reality and tele-operation.