Hybrid Assistive Limb

Chad Fair, *Biomedical Engineering, University of Rhode Island*
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***Abstract*— The Hybrid Assistive Limb, also known as HAL, is a powered exoskeleton designed to support and expand the physical capabilities of its users, particularly people with physical disabilities. This machine is capable of allowing the operator to lift and carry about five times as much weight as he or she could lift and carry unaided.**

I. Introduction

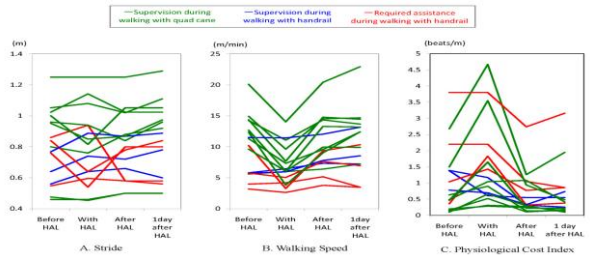
THE Hybrid Assistive Limb (HAL) was first developed by Dr. Sankai and the robotics company Cyberdyne. There are two versions of the Hybrid Assistive Limb: The HAL 5 and the HAL 3. The HAL 3 version is only designed for the Legs while the HAL 5 is a full-body exoskeleton for the arms, legs, and torso. HAL was purposely designed to assist the disabled and elderly in their daily tasks, but may also be used to support workers with physically demanding jobs. Also HAL used by disabled patients in hospitals, and can be modified so that patients can use it for longer-term rehabilitation. Japan's University of Tsukuba Cybernetics department describes this machine as the "fusion of human, machine and information systems." The HAL 5 only weighs only around 22 pounds and has its battery and control computer are strapped around the waist of the wearer which makes the suit very user friendly.

II. Methods

In order for the HAL 5 to work, the machine has to mimic the movement of the user as well as give the user enough support in order to complete its task. When a person attempts to move, nerve signals are sent from the brain to the muscles from motoneurons, moving the exoskeleton as a reaction. At this moment, very weak biosignals can be detected on the surface of the skin. HAL can read and interpret these signals through a sensor attached on the skin of the wearer. Based on the signals obtained, the power unit is controlled to move the joint in unison with the wearer's muscle movement, enabling HAL to support the wearer's daily activities.

III. Results

Over the past few years, HAL has exceeded everyone's expectations and has been seen as a major success in the medical field. By October 2012, over 300 HAL suits were in use by 130 medical facilities across Japan. In late February 2013, the HAL suit received a global safety certificate, becoming the first powered exoskeleton to do so. Cyberdyne has recently innovated and designed HAL suits specifically for the Fukushima cleanup. Recent research showed that patients who use HAL have increased stride length and walking speed compared to when they don't use it but after they take off the suit, their physiological cost index significantly decreased meaning no improvements were made which is surprising to the developers.



IV. Discussion

The Hybrid Assistive Limb shows a lot of potential in the future. Even though the cost of this suit is significantly high at the moment, Cyberdyne quotes the device will be more available to the public as time goes on and new models are made. The one important concept of HAL is that there is an endless amount of possibilities that could come from this machine whether it is helping rehab patients, construction workers, or just helping people with daily chores. Either way HAL has been revolutionary. One possibility developers are researching is therapeutic games using the machine where can stimulate cognitive activities and help disabled children walk while playing.

References

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