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Design of Haptic Vibrational Feedback Control in Upper Extremity Myoelectric Prostheses

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***Abstract*—Current prosthesis systems use haptic technology, have a brain-machine interaction that is dependent on visual feedback from the user, also have limitations by the details of the sense of touch both textures, roughness, weights, and contact forces applied. This research shows the development and implementation of haptic technology in a myoelectric prosthesis of the upper extremity, to simulate the sense of touch in the claw of the prosthesis to obtain a better control in the grip force taking as parameter the reaction and efficiency that the device has in different conditions for the patient to have an improvement in the feedback and the grip force of the prosthesis. For the development of the investigation, the VDI2206 methodology was used, simulating each part of the myoelectric prosthesis in different software for an improvement in the process of signal interpretation. Also by diagramming the motor execution process it facilitates the interpretation of the design. The results of the investigation show an alternative model of the conventional ones contributing with improvements in the signals received by the haptic prosthesis and better ergonomics, in addition, the perceived signals showed a better subjection and sensitivity. From the presented design it is desired to replicate to future research since the presented model can be taken as research material.**

Keywords—Haptics, VDI2206, automation, mechatronics, myoelectric, feedback

I. Introduction

Currently, most commercial myoelectric prostheses allow users the ability to control the prosthetic grip as well as open and close the hand by electrical signals, which are generated by the muscles of the associated arm [1-3]. They do not have extrasensory feedback and do have high risk and costly invasive methods such as intracortical microstimulation of sensory areas of the brain targeted reinnervation of residual sensory nerves [4] and electrical stimulation via brain implants [5].

For this reason, new technologies have been developed that have been adapted and improved according to the needs of users, including vibrotactile feedback technology [6-8 the main objective of being able to recognize the force applied to a certain object [9, 10]. Whether for reasons that may damage the object or otherwise not apply the necessary force and release them, this theory is based on the study of bilateral control between robots of different DOF [11], which is to perform bilateral control in grasping, which the functions of the prosthesis are represented in 3 different function modes, such as grasping mode, central position mode and deformation mode [12-14].

The user must have feedback with the system either in teleoperation of a robotic device such as Pisa/IIT SoftHand [15], neuroprosthesis, or exoskeletons as they interact with the environment [16, 17]. Current systems that have a brain-machine interaction are dependent on visual feedback from the user, it should be noted that they are limited by the details of the sense of touch whether textures, roughness [18], weights, and contact forces applied. While it is understood that visual feedback from the user is very useful in improving the experience of interaction with the machine (prosthesis), this interaction may not be very useful in specific cases when the user wants to lift an object or is required to participate in a process of pressure force sensitivity.

Haptic feedback during any activity the user has will be of much use by improving force regulation, being more efficient and effective in dexterous tasks and tasks involving tactile exploration, as the combination of glove type haptic interface and data arm provides external contact forces and internal grip forces [19]. The currently used methods of Haptic response based on "brain-machine" interface technology possess austere limitations, as they leave phantom limb sensation through the reallocation it has on nerve pathways. Phantom limb pain is a chronic and intractable condition that affects more than 2 million Americans [20].

However, the Haptic interface provides feedback of the sense of touch to the user physical properties; without specifying the technology employed, this makes it possible to return a stimulus to the user being employed in a commercial