Design of an Instrumented Cane for Real-Time Force Feedback

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INTRODUCTION

Stroke is a major cause of adult disability in the United States, as most of the 665,000 annual stroke survivors require some form of rehabilitation to improve gait[1]. Many affected persons require the use of an assistive device post-stroke[1], but the effects of these assistive devices on specific movement outcomes like propulsion in rehabilitation are not well studied[2].

The goal of this project is to study the effects of over-ground assistive devices on improving patient gait, as well as their significance on rehabilitation.

METHODS

An instrumented cane was constructed to measure the real-time force exerted on a walking device.

A force cell was fitted and held into place on to the end of a standard, single point cane using a custom designed 3D printed housing and cap.

This force cell is connected to an Arduino microcontroller kit with software programmed to read the force on the cane. Once 5% of an individual's body mass - or other user defined threshold - has been applied, the software vibrates an attached motor to provide tactile feedback to the user.

The force cell was calibrated first with a known 5 lb. weight, and the accuracy was tested against a force plate by loading the cane on in a manner similar to traditional cane use (Figure 1).

PRELIMINARY RESULTS

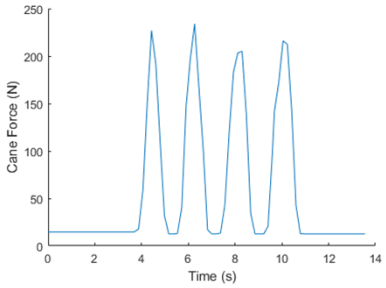

Figure 1. Peak forces recorded from four loading instances on the instrumented cane.

The average calibrated difference in force readings between cane and force plate data (Figure 2) was -1.933 N, which is only 0.68% of total average forces.

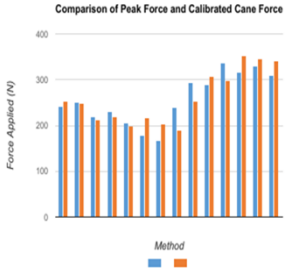

Figure 2. Comparison of force readings between the calibrated cane load cell and the force plate.

Based on these preliminary results, the prototype cane was found to be accurate, and can be used to give real-time feedback to users by vibrating when a threshold is reached.

DISCUSSION

Prior work has shown that there is an evident decrease in paretic propulsion, a key aspect of gait, with the use of assistive devices[3]. This study aimed to find a means of further investigating this trend and its effects on long-term rehabilitation.

We believe this knowledge can benefit clinicians in prescribing methods of rehabilitation that are cost efficient to improve walking speed and stability without hindering paretic strengthening.

Future studies will further investigate the assistive devise's effects on specifically paretic propulsion.

REFERENCES

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