Abstract

Stroke patients with somatosensory loss require effective therapy to improve sensation levels. To do so, clinicians must have an effective mechanism to quantify sensation. This device can assess pressure thresholds and two-point discrimination in all five fingers of the right hands of stroke patients. The entire procedure is automated for the ease of the clinician, and all data is logged onto an SD card for further analysis. With under $1500, this device can optimize therapy sessions and become a vital assistive tool in stroke rehabilitation clinics.

Problem

Can sensation thresholds in the hands of stroke patients be quantified in order to guide therapy? Can a device be constructed to automate the assessment procedure and assist clinicians in stroke rehabilitation?

Specifications

- Apply force to the index finger and thumb with two grams of resolution
- Perform two-point discrimination on the index finger and thumb
- Cost under $1500 to produce

Design Proposal

- Ergonomic palm rest for the right hand
- Two-point discrimination end-effectors for the fingers and thumb
- Motor to move two-point end effectors
- Motor to apply force
- Motor to move the device to each finger
- Fingertips are collinear on grip so motor can reach all fingers
- Two-point discrimination has 6 micrometer resolution
- Load cells have ~1.5 g resolution

Software Flow Chart

- Clinician sets up procedure prior to experiment on touchscreen
- Touchscreen is handed to patient during procedure to indicate his or her responses
- Data is continuously logged onto the SD card until the procedure is finished and a threshold is calculated
- An emergency stop button on the side of the touchscreen can halt the device at any moment

Analysis

- The maximum pressure for males is approximately 650 kPa
- The maximum pressure for females is approximately 400 kPa
- Using a cross-section of 4mm x 2mm, the maximum force that can be applied is:
  - For males: 5.2 N
  - For females: 3.2 N
- With our current design, a maximum of approximately 3 N can be achieved
- The stiffness of human skin is approximately 20 MPa, therefore the maximum force that can be applied to the skin with our design is 160 N
- This gives us a safety factor of about 53

Data

- Cyclic Tests for Load Cell Reliability
  - Load cell tested against a known mass for three continuous cycles
  - Hysteresis showed output variability versus the load to be anywhere from 0 to 1.2 grams

Literature


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