Algorithmic mapping of sensory trajectories in the hand based on transcutaneous median nerve stimulation

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Abstract—**Our hands are highly intricate structures with complicated pathways for sensation and motor control. When exposed to a nerve-affecting injury, the process of rehabilitation is long and complicated, with no guarantee of success. Studies have shown that electrical stimulation proximal to the injury site could provide a way to regain sensations in the distal parts of the hand. By stimulating in different activation patterns, it is also possible to create a sensation of movement along the hand, known as tactile motion. The aim of this study is to provide an algorithm that can help find electrode combinations used to evoke such sensations.**

Data was gathered from multiple volunteers in order to evaluate how electrical stimulation on the median nerve would be perceived among able-bodied participants. The participants registered the location of the hand where they felt a sensation, and this was analyzed in relation to the activation in the multipad electrode.

The main results were that areas of the thumb are most likely to be activated and the activation is primarily related to the electrodes on the outer part of the multipad electrode. A significant difference was also observed between the multipad electrode placement on the right and left wrist regarding which electrodes activate specific areas of the hand.

In conclusion, the study provided an algorithm capable of statistically determine along which lines in the hand it is possible to create a sensory trajectory.

I. Introduction

THE human hand has the ability to perform complicated tasks ranging from delicate maneuvers to powerful grips, a competence that distinguishes humans from most other animals. Fine motor skills and sensory feedback have supported our basic survival as well as enabled documentation, creativity and technological advancement. Evidently, the hand plays an important part in how we as humans interact with the world and interpret our environment.

A. Anatomy of the hand

The functionality of the hand is made possible by the cooperation between the peripheral and central nervous system. Sensory information is gathered from a network of receptors located in the skin, muscles and joints which are specialized in detecting different types of stimuli, for instance pressure, temperature and vibration. These signals are transmitted through the peripheral nerves, such as the median nerve, to the brain and spinal cord. The central nervous system processes and interprets the incoming signal and generates an appropriate motor response that travels back through the peripheral nervous system, resulting in precise movement [1] [2]. Demonstrated in figure 1, the median nerve is a primary pathway for the thumb, index finger, middle finger as well as half of the ring finger. The ulnar nerve activates the other half of the ring finger as well as the little finger [3].

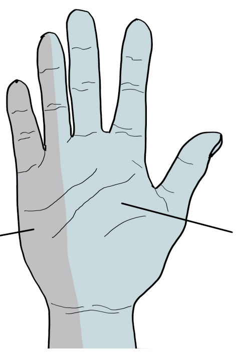

Figure 1. Distribution area of the median nerve and ulnar nerve.

In cases of nerve injury, the communication between the hand and the brain can be severely affected. The complex nature of the hand makes recovering from a major nerve injury a lengthy process with no guarantee of full restoration. The healing process typically requires complex surgical reconstruction and up to 6 months of axon reinnervation. This reinnervation process requires the damaged axons to regenerate from the injury site to reconnect with the appropriate peripheral receptors, a task that is not always successful. Dead or misrouted axons could cause chronic sensory deficits or dysfunctional motor recovery [4] - [6].

B. Previous research

In a previous study it has been demonstrated that electrical stimulation can increase the levels of brain-derived neurotrophic factor (BDNF) and its receptor TrkB which are crucial for neuronal survival and axonal regeneration [7]. This indicates that the recovery from nerve damage can be positively improved by electrical stimulation. Through targeted stimulation it is possible to evoke specific sensations and

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help the brain establish new meaningful connections between stimulus and response.

In another study conducted by Malesevic et al., transcutaneous electrical stimulation was used to evoke localized sensory perceptions in the hands of healthy individuals. The researchers tested different types of stimulation parameters to identify configurations that could produce natural sensations in specific areas of the hand. By calibrating each electrode individually and evaluating the perceived sensations, it was possible to demonstrate that different regions of the hand can be separately activated non-invasively [8].

An important part of how we perceive natural touch is our ability to detect movement across the skin, known as tactile motion. In one study it was possible to induce the perception of continuous motion trajectory by utilizing timing and amplitude levels of transcutaneous electrical stimulation. The study demonstrates the potential to create realistic sensations of movement, something that could be of high value when developing devices that give sensory feedback, such as prosthetics and tools used in rehabilitation [9].

C. Thesis

This study aims to investigate how electrical stimulation of the median nerve can be used to recreate sensations in the hand. By mapping the relationship between different stimulation parameters such as amplitude, location and the perceived sensation, the intent is to develop an algorithm that assist in finding relevant sensory trajectories of the hand.

Electrical stimulation of peripheral nerves is shown to be promising in rehabilitation and restoring sensation after nerve injuries. However, most of the current studies focus on isolated points of stimulation, rather than creating dynamic and coordinated motions. Being able to reproduce a coordinated tactile motion by electrical stimulation that mimics a natural sensation, is thought to improve rehabilitation opportunities for patients recovering from nerve injuries. Through experimental data collection, algorithm development and testing, we aim to gather a better understanding of how electrical stimulation parameters may be translated into a perceived movement. Hence, this study has the potential to contribute to the development of more effective rehabilitation methods.

D. Agenda

To investigate how electrical stimulation can recreate the sensation of movement in the hand, the paper begins by describing the experimental setup and the procedure of data collection. It then explains how the algorithm was developed based on the collected data from previous experiments, and how the algorithm was evaluated. Finally, an analysis is done on the conducted data with the support of the developed algorithm in order to draw conclusions about the possibility of finding a potential tactile motions across the hand.

II. Method

A. Equipment

The experimental setup consisted of two types of transcutaneous multipad electrodes, both developed by Tecnalia. One type included 8 individual electrodes, with a conductive gel applied between the electrodes and the skin to ensure effective electrical contact. The other configuration featured 16 electrodes, each covered with a conductive plastic interface that allowed for direct skin contact without the need for gel.

Electrical stimulation was delivered using a multichannel stimulator (Tecnalia), connected physically to the multipad electrode and through bluetooth to a computer. The computer featured a custom-designed graphical user interface (GUI) developed in LabView. The stimulator and 16-electrode multipad are shown in figure 2. The GUI enabled individual calibration of each electrode by determining the minimum amplitude required to evoke a perceptible sensation. Stimulation amplitudes ranged from 1 to 10 mA. The software also allowed adjustment of stimulation parameters such as frequency and duration as well as collecting data regarding the participants' perceived sensations.

Figure 2. Tecnalia multichannel generator connected to a 16-electrode multipad.

B. Subjects

All participants included in the study were able-bodied individuals between the ages of 20 and 25. Exclusion criteria comprised pregnancy, epilepsy, neurological disorders, previous hand surgery, and the presence of an implanted pacemaker or other heart-monitoring devices.

A total of 12 participants took part in the study, which was divided into two separate rounds of testing. The first round involved ten participants and utilized the 8-electrode multipad, while the second round employed the 16-electrode configuration, with 6 participants taking part. In total, 16 tests were conducted. This number does not reflect the number of unique individuals, as some participants were involved in both testing rounds.

C. Protocol

1) Information: Before the execution of the test, each participant was informed about the purpose of the study, the test procedure and any potential risks of electrical stimulation. Prior to participation, each participant received an information and consent form (appendix 1), which they signed to verify that they had understood the study and procedure, and to confirm that they did not belong to any of the risk groups.

2) Preparation: The electrode was placed on the wrist of the non dominant hand of the participant as shown in figure 3. In order to prevent any movement of the electrodes during the test, it was secured with a strap. The hand was kept rested on a table during the entire test duration.

Figure 3. Placement of the multipad electrode on the participants wrist, held in place by an elastic strap.

3) Calibration: Prior to the stimulation tests, each electrode was calibrated to determine the participant-specific thresholds for perceived electrical stimulation. This aimed to define two amplitude levels per electrode, a lower and upper threshold. The lower amplitude level corresponds to the minimum current at which a clear sensation in the hand was perceived while the upper represents a strong sensation.

Stimulation frequency and pulse train duration were fixed at 50 Hz and 1000 ms, respectively, and the calibration process was carried out electrode by electrode. Beginning at an amplitude of 1mA, the stimulation amplitude was gradually increased in small increments. If the participant reported a sensation localized solely at the wrist, this was noted but not considered as the lower threshold. Electrodes that only produced sensation at the stimulation site (the wrist) were excluded from further testing, since the aim was to investigate the sensations spread to the hand. If an electrode generated uncomfortable sensations for the participant, that electrode was also excluded from further testing.

When a participant reported the first clear sensation in the hand, the corresponding amplitude was set as the low amplitude level. The stimulation intensity continued to increase until the participant experienced a strong but tolerable sensation, and the corresponding amplitude was then set to the high amplitude level.

4) Parameter settings: Only electrodes that had evoked clear and localized sensations in the hand during the calibration process were included in the test. Other settings such as frequency and duration were manually set according to table I and remained consistent throughout the following test. Two amplitude levels were used (low and high) as well as two repetitions. Randomly repeating each stimulus twice verified consistency in perception.

Table I
SETTINGS APPLIED TO THE MULTICHANNEL GENERATOR WHEN CONDUCTING THE TESTS.

Amplitude levels	2
Repitions	2
Frequency	50 Hz
Duration	1000 ms

5) Test: Following the calibration of electrodes, the main stimulation test was conducted. The aim of the test was to systematically investigate how the location of activated electrode along with its amplitude value influenced the perceived area of sensation in the hand.

The electrical stimulation tested the electrodes previously defined amplitude levels, low and high. All selected electrodes were activated in a randomized sequence through the LabVIEW interface. For each stimulation event, the participant was asked to report the location of the sensation by marking an area of the map shown in figure 4.

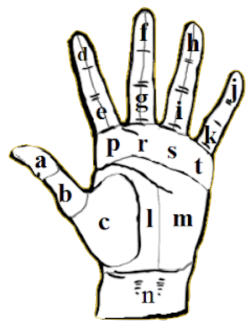

Figure 4. Somatosensory map of the hand. Different regions of the hand are labeled as a specific letter.

In cases where the sensation was unclear, the stimulus could be repeated manually via the interface. After the participant had rated each stimulus, the next stimulation sequence was automatically triggered.

D. Algorithm development

As mentioned earlier, the different regions of the hand were represented by a letter in the mapping system (figure 4). In the stimulation data collected from participants, the regions of perceived sensation were instead represented as numerical values that corresponded to a specific area of the mapping system. The numerical values were decoded into its corresponding letters using MATLAB.

The primary goal was to identify sequences of activation areas that together formed a coherent trajectory from the fingertips to wrist, defined in table II by the study conductors. Using MATLAB, an algorithm was developed to offer support in the search of combinations of perceived activated areas that matched any of the predefined lines.

Table II
DEFINED LINES RUNNING FROM FINGERTIP TO WRIST, LABELED FROM 1-6.

Line nr	included areas
1	A - B - C - N
2	D - E - P - L - N
3	D - E - P - C - N
4	F - G - R - L - N
5	H - I - S - L - N
6	J - K - T - M - N

The algorithm created an empty matrix of dimensions i x j, where i represented the number of tested stimulus and j the number of predefined lines. For each stimulus, the perceived activation areas were compared to each defined line, see table II. For every matching letter between the perceived sensation areas and the line, a value of 1 was added to the corresponding cell (i, j) in the matrix. The total sum for each cell was then divided by the total number of areas activated by the stimulus. This resulted in a percentage indicating how well each stimulus matched to each line in the hand.

A second matrix was then created with dimensions i x j, where i represented the number of electrodes used during testing and j the number of predefined lines. A threshold was set to 75%, meaning only stimuli with at least 75% correspondence to a line were considered. The threshold was decided through trial and error until an appropriate amount of electrodes was suggested by the algorithm. For example, if the perceived activation areas were M and N, this would result in a 100% match with line 6, but only 50% with lines 1-5. If electrode 3 was responsible for this stimulation, a value of 1 was added to cell (3,6) in the matrix. This resulted in a final matrix describing how frequently each electrode had matched with every line, based on the threshold.

In order to provide a better analysis of the potential trajectories, the regions of activation in the fingers were also investigated separately, excluding areas of the palm and wrist,. The same algorithm was used, but now searching for matches between the lines seen in table III.

Table III
DEFINED LINES RUNNING THROUGH THE FINGERS, LABELED FROM 1-6.

Line nr	included areas
1	A - B - C
2	D - E - P
3	D - E - P
4	F - G - R
5	H - I - S
6	J - K - T

Lines 2 and 3 in this table are identical but kept that way in order to keep the relations with the entire hands and to simplify the discussion of the areas. The threshold for the lowest acceptable match between activated regions and the line through the fingers was lowered to 50%, due to less areas being included. Analyzing the fingers separately enabled a better analysis of potential lines that were coherent from the fingertip.

E. Data evaluation

Data from each participant was analyzed one by one with the algorithm, and bar charts were created for both electrode activation along the whole line and for solely activation in the fingers. This way, the developed algorithm was evaluated in order to determine its effectiveness in finding candidate electrodes that could be used to recreate a tactile motion across the hand.

The collected data from each participant were then combined and represented as bar charts by the algorithm in order to draw overall conclusions of the ability to find continuous lines of sensation.

Due to the tests being conducted on the non dominant hand of each participant, the tests were also divided into a left handed and right handed group. This enabled further analyzing of the placement of the electrodes, and its corresponding sensory trajectories.

III. RESULTS

A. 16 electrode multipad

The algorithm provided bar charts of how often each electrode had activated regions that matched above 75% with the six different predefined lines of the hand. Thus, the algorithm gave suggestions of electrodes that could be used to create a coherent sensation along the trajectories on the different participants. A combined result from each measurements using the 16 electrode pad is shown in figure 5. Figure 6 provides the combined result from activation solely in the fingers.

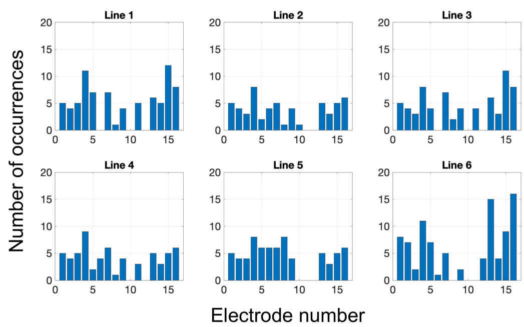

Figure 5. Electrodes activated in the predefined lines of hand, all participants from 16-electrode multipad included.

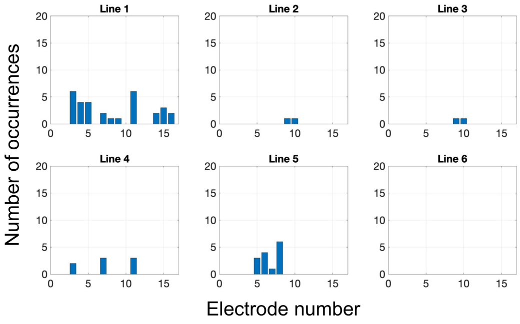

Figure 6. Electrodes activated in the predefined lines of fingers, all participants from 16-electrode multipad included.

Looking at the bar charts of activated regions in the hand to bar charts of activated regions solely in the fingers it can be seen that most of the perceived regions of sensation from the data collection have been in the wrist and palm. The number of occurrences in electrodes that stimulated regions of the hand were much higher than the amount of electrodes that had stimulated regions in the fingers.

When comparing the result from the activated lines in the fingers to the total hand, it can be seen that the electrodes have activated line 1 most frequently. Figure 7 and 8 shows bar charts of the right handed participants. The electrodes that have provided stimulation in the thumb is mainly electrode 3-5. The graphical representation of the result from left handed participants, seen in figure 9 and 10, shows that the opposite side of the electrode pad, electrode 14-16, have activated the thumb most frequently. In a similar way it can be seen that line 6 is activated by opposite ends of the electrode spectrum when comparing right and left-handed results. Trajectories 2-5 had a more central distribution of activated electrodes.

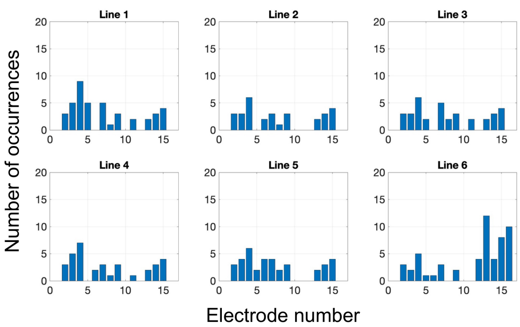

Figure 7. Electrodes activated in the predefined lines of hand, right-handed participants from 16-electrode multipad included.

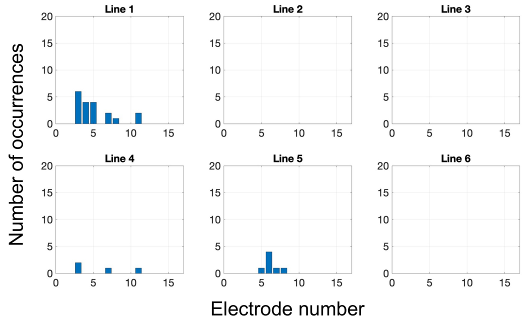

Figure 8. Electrodes activated in the predefined lines of fingers, right-handed participants from 16-electrode multipad included.

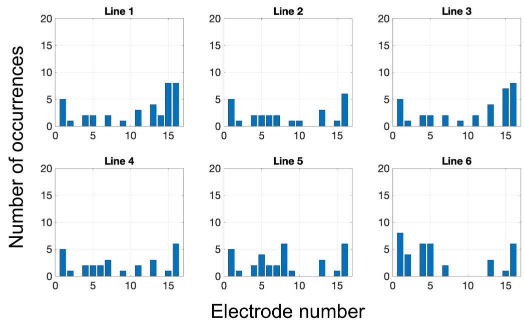

Figure 9. Electrodes activated in the predefined lines of hand, left-handed participants from 16-electrode multipad included.

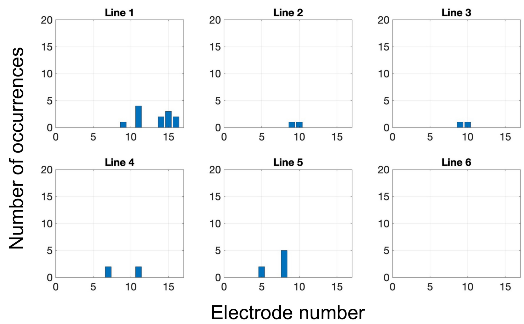

Figure 10. Electrodes activated in the predefined lines of fingers, left-handed participants from 16-electrode multipad included.

Figure 11 shows how often electrodes have corresponded to each line in the fingers with at least a 50% match. Based on this figure, line 1 is most commonly activated (as previously noted), as well as line 5 from the ring finger to wrist. Line 4 has also been activated in the fingertips for some participants while the index finger, which is represented by both line 2 and

3, is rarely stimulated. Figures 5 and 12 show that line 6 is frequently stimulated, however, when comparing to the result in figure 6, from isolated evaluation of the fingers, line 6 is never activated.

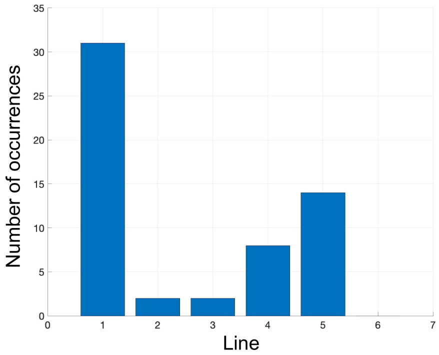

Figure 11. Total activation in predefined lines of fingers, all participants from 16-electrode multipad included.

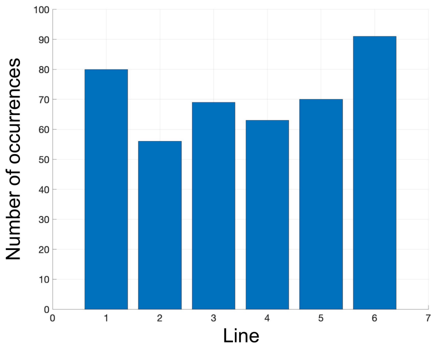

Figure 12. Total activation in predefined lines of hand, all participants from 16-electrode multipad included.

B. 8 electrode multipad

The algorithm was also used to analyze the data conducted from the tests with the 8-electrode multipad. Figure 13 shows the combined result of matches between electrode 1-8 and the predefined trajectories in the hand (table II), all participants included. It can be seen that each trajectory have had several matches with every electrode at some part of line from fingertip to wrist. However, when analyzing the bar charts in figure 14, illustrating how often electrodes have evoked sensations in the fingers of each line, the number of matches are much fewer. Hence, the electrodes have stimulated the wrist and palm the most often.

Furthermore, figure 15 illustrates the total number of times that each electrode 1-8 have evoked sensations in any part of the predefined lines across the hand. Figure 16 shows the number of electrodes matching with each trajectory in the fingers. From this result, it can also be seen that the frequency of matches with the fingers are noticeably fewer than with the total line in the hand. The number of occurrences in electrodes matching with the fingers, using the 8-electrode multipad, are more evenly distributed over each line compared to the 16-electrode multipad.

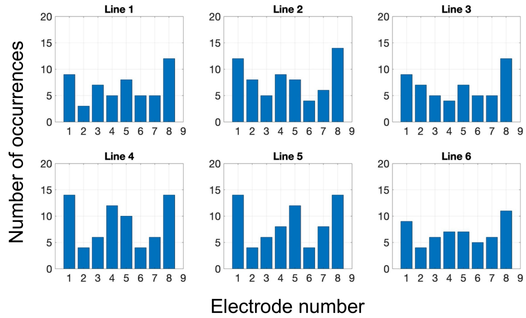

Figure 13. (8-electrode multipad) Electrodes activated in the predefined lines of hand, all participants from 8-electrode multipad included.

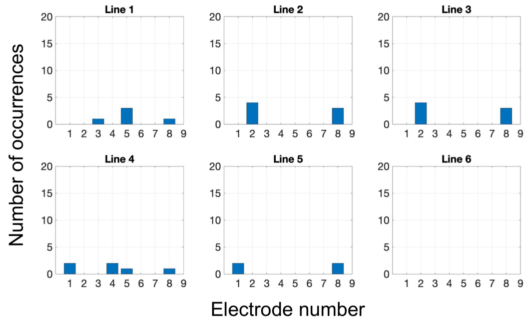

Figure 14. (8-electrode multipad) Electrodes activated in the predefined lines of fingers, all participants from 8-electrode multipad included.

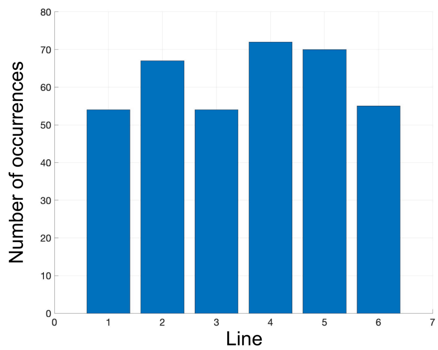

Figure 15. (8-electrode multipad) Total activation in predefined lines of hand, all participants from 8-electrode multipad included.

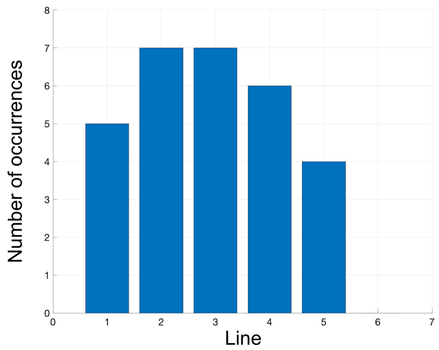

Figure 16. (8-electrode multipad) Total activation in predefined lines of fingers, all participants from 8-electrode multipad included.

IV. Discussion

A. Data evaluation

The high activation frequency in line 1 suggests that the thumb is more easily targeted through electrical stimulation, an observation that aligns with the distribution area of the median nerve. The result in figure 8 and 10 show that the electrodes providing these sensations in the thumb are nearby eachother, suggesting that they stimulate the same specific area of the wrist. Particularly, an area of the wrist where nerve branches are associated with the thumb. Due to testing being done on the non dominant hand, electrode 1-16 were distributed differently between right-handed and left-handed participants, creating a mirrored effect between which electrodes activated which areas of the hand. Unexpectedly, the index finger has a low activation frequency from the 16-electrode multipad despite being a central part in median nerve innervation. However, this inconsistency is not present in the results from the 8-electrode multipad.

The 8 electrode configuration displayed a more scattered distribution in terms of which electrodes activated the specified lines, in comparison with the 16-electrode multipad. This is likely due to the gel pad positioned between the electrodes and the skin. Unlike the 16-electrode multipad, where each electrode has an individual conductive plastic interface, the gel pad in this case spans the entire electrode area. As a result, the stimulation is probably distributed throughout the entire surface of the multipad electrode, causing it to have a less specific point of stimulation. Comparing figure 14 to figure 6 it can also be seen that the 16-electrode multipad has evoked sensation in the fingers more frequently than the 8-electrode multipad. This indicates that the 16-electrode multipad would be more suitable when recreating a tactile continuous motion from the fingertip to the wrist.

Line 6 was never activated in the fingers but frequently activated in the palm, indicating that the multipad electrode was able to stimulate the ulnar nerve in addition to the median nerve (see figure 1). This is true for both the 16-electrode multipad and the 8-electrode mulitpad. As seen in figure 2 and 3 the 16-electrode multipad electrode covers a relatively big part of the wrist which makes this stimulation plausible. The coverage area of the 8-electrode multipad is not significantly smaller.

The ring finger was frequently activated by both the 8-electrode multipad and the 16-electrode multipad and its sensation is connected to both the median nerve and the ulnar nerve. However, as mentioned previously line 6 was only activated in the palm, indicating that the ulnar nerve did not manage to stimulate distally towards the fingers. This suggests that the ring finger is primarily activated by the median nerve. In addition to this, many participants stated that it was often hard to distinguish between sensations in the middle finger and ring finger. This would align with the theory of the ring finger being activated by the median nerve since it only stimulates the half of the ring finger closest to the middle finger.

An interesting observation is that electrode 4 in the 16-electrode configuration had a relatively high correspondence frequency across all of the predefined trajectories of the hand, while it was only present in line 1 when considering the finger-specific activations. This might indicate that electrode 4 is involved in activation of areas in the palm as well as the thumb. Line 1 of the fingers includes area C which is at the base of the thumb and closer to the palm, combined with the limited association with the other fingers it makes it plausible that electrode 4 does not stimulate nerves that extend distally. It might also reflect a location on the wrist where sensory branches overlap, evoking ambiguous sensations.

Another noteworthy observation is that electrodes around position 10 were rarely associated with sensations corresponding with the defined lines. This suggests that these electrodes were often placed outside of the optimal stimulation area.

B. Challenges in data collection

There was a significant variability in the functionality of the electrodes with some of them becoming less effective after only a few uses. This was usually discovered during the calibration phase of the various tests at which point we would attempt to replace the multipad with one that worked. However, it was not always successful in fixing the issues with weak stimulations. In a few cases we had to continue the test with poorly working electrodes, due to the volunteers limited time, resulting in barely usable data from the session.

The process of mapping the areas of perceived sensation also introduced some uncertainty. Many participants stated that they experienced the sensation in a location that did not correlate perfectly with any of the predefined areas of the somatosensory map, causing them to choose areas that did not feel entirely correct.

Consistency of electrode placement presents another challenge in this experiment. Reproducing the exact positioning of the multipad across multiple participants is not realistically possible, inevitably causing stimulation to slightly differ between individuals. These variations affect how the median nerve is targeted and, consequently, how the different areas of the hand are activated.

The difference between right-handed and left-handed participants also raised an issue when left-handed persons were evaluating the sensations, due to the somatosensory map displaying a left hand. This made it less intuitive for left handed participants to fill in the perceived areas and may have influenced their reported sensations.

C. Further development of algorithm

The developed algorithm is a simple tool to support the identification of candidate electrodes that may be used to recreate a continuous tactile motion across the hand. It is used as statistic guidance, indicating how frequently electrodes evoked stimulus that matched the predefined lines. However, the current algorithm is limited in both functionality and automation, leaving several opportunities for further development. For instance, the algorithm is searching for matches between perceived sensation areas and trajectories across the hand that we defined ourselves, shown in table II and III. In reality, there are more combinations of regions that would create a continuous line. Hence, the search for potential trajectories in the algorithm could be improved. The algorithm could also generate a more clear answer to potential trajectories in order to mimic a continuous sensation across the hand, generating for instance the specific order of electrode activation.

Furthermore, the algorithm does not take into account the amplitude of the electrical stimulation. However, the test results from the data collection showed that different amplitudes do not change the area of perceived sensation, but rather the intensity of sensation. A stimulus with a low amplitude might not activate regions in the fingers but solely create a weak sensation in the wrist. In order to mimic a natural sensation, the amplitude could be taken more into account when it comes to development of algorithm.

D. Ethics

An information and consent form (Appendix 1) was sent out to all interested participants before they were asked to book a time slot for test execution. The form contained information about the aim of the study, how the test will be conducted, as well as the previously mentioned exclusion criteria. The participants were asked to read through the form before coming to the testing site where it was signed.

During the tests, participants were in full control of the stimulation intensity. Each electrode were individually calibrated to levels that felt comfortable for the volunteer and they were constantly reassured that they determined the values. The actual test performed after calibration was carried out by the participants themselves, with guidance provided by the test administrators.

Additionally, the data was collected anonymously with each participant receiving a identification number only known by the people conducting the study.

E. Sustainability

The experimental setup used transcutaneous multipad electrodes consisting of metal and plastic, materials that are not inherently sustainable. Most plastics are fossil-based and the extraction and processing of metal is energy-extensive, making them harmful for the environment. However, the sustainability of the materials also depends on the ability to reuse or recycle them. During the study it was discovered that the functionality of the electrodes were decreased after only a few uses, a fact that is concerning from a sustainability standpoint.

This study also utilized the computer programs LabVIEW and MATLAB. When interfacing with hardware in real time, such as during our tests, LabVIEW is considered to have a high energy demand. Regarding MATLAB, only large datasets and heavy simulations demand a lot of energy which is not applicable to this study.

In contrary to these negative impacts, this study also provides a positive impact on our society as a whole. By contributing to improved rehabilitation of the hands, this research could enable more individuals to regain fine motor skills that are essentials for many everyday tasks. This will lead to increased independence and participation, which in the long term will have a positive impact on societal sustainability.

V. Conclusions

The developed algorithm supported the identification of predefined lines across the hand and also provided candidate electrodes that could be used to recreate a tactile motion along these lines. Line 1 was found to be most consistently activated from fingertip to the wrist, suggesting that this path has the highest potential to be recreated as a coherent sensation of movement.

VI. Acknowledgments

We would like to thank everyone that participated as volunteers in this study in order to provide us with data that could be analyzed. We also want to thank our supervisor Nebojsa Malesevic who has provided all of the equipment as well as guiding us through the project.

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Deltagarmedgivande

Bakgrund

Våra händer är beroende av hur receptorer och nerver i det perifera nervsystemet samverkar med sensoriska och motoriska system i det centrala nervsystemet. Receptorer reagerar på stimuli och skickar signaler till hjärnan där de tolkas som känselintryck. Vid en nervskada når inte nerverna ut till receptorerna och återhämtningsprocessen för att återkoppla nerver är lång och komplex. Elektrisk stimulering används för att aktivera nerver och stimulera somatosensoriska cortex för bättre återhämtning. Denna studie syftar till att stimulera medianusnerven på handleden för att framkalla känsel i olika delar av handen.

Testet

En transkutan elektrod placeras på handleden över medianusnerven. Först genomförs en kalibrering av elektroden genom att gradvis öka amplituden från en låg nivå. På så sätt bestämmer du som testperson vilken som blir den lägsta och högsta nivån av stimuli som du kommer att uppleva under testet. Efter kalibreringen påbörjas testet. Ett antal stimuli skickas ut, och genom att fylla i en somatosensorisk bild av handen beskriver du vart du upplevt stimuleringen någonstans och hur det kändes. Totala tiden för test och kalibrering är cirka 30-40 minuter.
OBS! Det är okej att avbryta när som helst under testet om det inte känns bra, din signatur är inte bindande.

Risker

Amplitudnivåerna som används i testet är inte farliga och det finns inte bieffekter av processen. Däremot bör du inte delta om någon av följande riskkriterier stämmer på dig: gravid, epileptiker, neurologisk sjukdom, pacemaker implantat, hjärtövervakande utrustning, tidigare operation av hand.

Datahantering

Datan från testet kommer att sparas som en fil på samma dator som testet genomförs. Flera personer har tillgång till denna dator men din specifika data kommer att vara anonymiserad och endast ha en siffra, inget namn. Alice och Ebba kommer även ha tillgång till testdatan på deras personliga datorer samt ha tillgång till information om vilket nummer som tillhör vilken person. I redovisningen av datan kommer den att vara anonymiserad.

Skriv på nedan för att bekräfta att du läst informationen och vill delta i studien.

Signatur: ____

Namnförtydligande: ____

Datum: ___/___ - 2025