Slotevent Interreg IV "Revalidatie Robotica II"
IVA-VLANED-1.14

Technologische innovaties voor evaluatie en training van de arm bij personen met MS en CVA: project realisaties

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Informatiebundel

Inhoudsopgave

Programma

16.00u Onthaal

16.30u Toelichting van de projectresultaten

Verwelkoming en situering van het project
M. Vandeput, Gedeputeerde van Economie, Provincie Limburg
B. Lambrechts, Algemeen Directeur PHL
Projectleiding: B. Op 't Eijnde en P. Feys, REVAL (PHL)

Virtuele leeromgeving voor revalidatierobotica: ontwikkeling van I-TRAVLE
A. Timmermans (Adelante Kenniscentrum)
*K. Coninx (*UHasselt*) ism alle partners*

Bewegingsregistratie buiten het lab: ontwikkeling van MMAAS
K. Meijer, Universiteit Maastricht
ism FABER (KUL), bewegingslabo Pellenberg

Ervaringen van patiënten en zorgverleners
L. Kerkhofs (RMSC Overpelt),
ism revalidatiecentra Blixembosch en Adelante Hoensbroek

18.00u Demonstraties van I-TRAVLE en MMAAS
Posterpresentaties
Netwerkreceptie

20.00u Einde programma

Informatie "Revalidatie Robotica II"

Na een CVA of bij Multiple Sclerose is de armfunctie dikwijls aangedaan. Dit heeft een behoorlijke impact op het dagelijks functioneren. Om de revalidatie van de armfunctie bij deze patiënten te verbeteren, werd het Interreg IV "Revalidatierobotica-II" project (Provinciale Hogeschool Limburg) opgestart.

Het Revalidatierobotica-II project werd gefinancierd door het Europese Interreg programma, de Vlaamse en Nederlandse overheid, de provincies Belgisch Limburg, Vlaams-Brabant, Nederlands Limburg en Nederlands Noord-Brabant. De Provinciale Hogeschool Limburg was leider binnen dit project, en werkte samen met meerdere binnen- en buitenlandse partners waaronder het Expertisecentrum voor Digitale Media (Uhasselt), het Revalidatie & MS-centrum te Overpelt, het kenniscentrum Adelante uit Hoensbroek (NL), het Revalidatiecentrum Blixembosch en de Technische Universiteit uit Eindhoven (NL), de Universiteit Maastricht (NL) en de faculteit FABER van de KULeuven.

Het project omvatte 2 projectdoelen:

In samenwerking met het Expertisecentrum voor Digitale Media van de UHasselt, werd ten eerste het I-Travle systeem ontwikkeld (www.i-travle.eu). Dit is een softwarepakket waarbij de gebruiker/patiënt met de arm door een virtuele omgeving beweegt en waarbij een robot een kracht terugkoppelt aan de gebruiker. Hierdoor kunnen stimulerende bewegingstaken aangereikt worden tijdens de revalidatie van de armfunctie. Om de bruikbaarheid en effectiviteit van dit softwarepakket te onderzoeken, werden verschillende studies opgezet.

Een tweede doel was het ontwikkelen van een draagbaar meetsysteem voor de registratie van armbewegingen. De mogelijkheid om armbewegingen te registreren is essentieel voor de therapieplanning . Daarom werd het draagbare meetsysteem, de MMAAS (Motion and Muscle Ambulatory Activity System) ontwikkeld door de Universiteit Maastricht (UM), in samenwerking met de faculteit FABER van de KULeuven. Het is systeem is erg gebruiksvriendelijk voor de patiënt en therapeut aangezien de meetsensoren zijn ingebouwd in een jasje.

i-travle

MMAAS

Project partners

REVAL Rehabilitation Research Centre
Provinciale Hogeschool Limburg
Bert Op 't Eijnde, Peter Feys, Geert Alders, Hanne Bastiaens, Ilse Lamers, Ilse Baert, Els Knippenberg, Caroline Windmolders

Expertisecentrum voor Digitale Media
Universiteit Hasselt
Karin Coninx, Tom De Weyer, Sofie Notelaers, Karel Robert, Chris Raymaekers, Joan De Boeck

Dept. of Human Movement Sciences
MUMC+, Universiteit Maastricht
Hans Savelberg, Kenneth Meijer, Alessio Murgia

Human Technology Interaction
Eindhoven University of Technology
Wijnand Ijsselsteijn, Wouter van den Hoogen

Faculteit Bewegings- en Revalidatiewetenschappen
Katholieke Universiteit Leuven
Kaat Desloovere, Hilde Feys, Ellen Jaspers, Liesbet De Baets

Revalidatie & MS centrum Overpelt
Patric Groenen, Veronik Truyens, Lore Kerkhofs

Adelante - Kenniscentrum Revalidatie en Audiologie
Henk Seelen, Richard Geers ism Annick Timmermans en Annemie Spooren

Blixembosch Revalidatiecentrum
Ben van den Brand, Arne Goedhart

Met grootste dank aan de deelnemers van de gebruikerstesten en interventiestudies

Klankbordleden

Revalidatiecentrum De Mick

Spronken Orthopedie NV

Syntens & Life Tech Zone

Enraf-Nonius NV

UZ Leuven Campus Pellenberg

MOOG

AZ Alma – Mensana

Nationaal MS Centrum

Maastricht Instruments

Life Tech Limburg

Gyma-Uniphy

N.V. Brabantse Ontwikkelings Maatschappij

Proteion

FOCAL Meditech BV

Revalidatiecentrum St-Ursula

“Revalidatie Robotica II” – Papers, proceedings en abstracts

- **2008**

Robot-aided rehabilitation of the upper limb in persons with Multiple Sclerosis: A usability and effectiveness study P. Feys, G. Alders, D. Gijbels, J. De Boeck, T. De Weyer, K. Coninx, C. Raymaekers, J. Annegarn, K. Meijer, H. Savelberg, V. Truyens and M. Thijs,(2008), ACM IEEE Human-Robot Interaction Conference HRI08, workshop “Robotic Helpers: User Interaction, Interfaces and Companions in Assistive and Therapy Robotics” p49-52.

The learning effect of force feedback enabled robotic rehabilitation of the upper limbs in persons with MS – a pilot study. J. De Boeck, T. De Weyer, C. Raymaekers, K. Coninx, G. Alders, D. Gijbels, P. Feys (2008). In: Proceedings of the 5th International Conference on Enactive Interfaces (ENACTIVE08). p. 117-122.

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- **2009**

Arm Training in Multiple Sclerosis Using Phantom: Clinical Relevance of Robotic Outcome Measures. P. Feys, G. Alders, D. Gijbels, K. Coninx, C. Raymaekers, J. De Boeck, T. De Weyer, V. Truyens, P. Groenen, H. Savelberg, K. Meijer, B. Op’t Eijnde, ICORR International Conference on Rehabilitation Robotics 2009: Reaching users and community, Kyoto, Japan, IEEE-ICORR p576-581.

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- **2010**

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Data Management for Multimodal Rehabilitation Games, Sofie Notelaers, Tom De Weyer, Chris Raymaekers, Karin Coninx, Hanne Bastiaens, Ilse Lamers, Database and Expert Systems Applications, International Workshop on, pp. 137-141, 2010 Workshops on Database and Expert Systems Applications, 2010

A Portable Device for the Clinical Assessment of Upper Limb Motion and Muscle Physiology, Technische paper voor de Institute of Electrical and Electronics Engineers - Engineering in medicine and biology conference (IEEE EMBC), Alessio Murgia, Vincent Kerkhofs, Hans Savelberg, and Kenneth Meijer (UM)

Vlaanderen
Publicatie in de Vlaamse Brabander, het informatiemagazine van de provincie Vlaams-Brabant. Artikel verschenen in nummer 38 ‘Onze kennis, onder toekomst’, oktober 2010, pagina 10-11.

- **2011**

Effects of shading and droplines on object localization in virtual rehabilitation for patients with neurological conditions, W. van den Hoogen, P. Feys, I. Lamers, S. Notelaers, K. Baeten, L. Kerhofs, K. Coninx and W. IJsselsteijn, ICVR 2011 - International Conference on Virtual Rehabilitation, pp. 1 - 6, IEEE, ISBN 978-1-61284-473-2, Jun. 2011.

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Measuring shoulder angles using the MMAAS: a wearable IMU-based device for motion and muscle function assessment, Alessio Murgia, Vincent Kerkhofs, Hans Savelberg and Kenneth Meijer, 3de Dutch Biomedical Engineering Conference 2011

Watering the flowers: virtual haptic environments for training of forearm rotation in persons with central nervous deficits. De Weyer T, Notelaers S, Coninx K, Feys P, Lamers I, Alders G, Geers R., 25-27 Mei 2011, Creta (Greece). The 4th International Conference on PErvasive Technologies Related to Assistive Environments (PETRA)

Individualized training for MS- and stroke patients in I-TRAVLE. Notelaers S, De Weyer T, Octavia J, Coninx K, Feys P. SKILLS meeting, December 2012, Marseille, France

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Vlaanderen
Artikel in Axxon, vaktijdsschrift van de Belgische vereniging voor kinesitherapie, Juni 2011 ‘Al gamend revalideren?’, p.1-3

- **2012**

Reliability of the MMAAS in patients with multiple sclerosis.Murgia A., Alders G., Kerkhofs L., Feys P., Savelberg H., Meijer K. In: XII International Symposium on 3D Analysis of Human Movement, Technology and Treatment, Bologna, Italy, 18-20 July 2012

Volledige papers beschikbaar op aanvraag

Posterpresentaties: abstracts

1. DESIGN OF AN ACTIVE ORTHOSIS CONTROLLING SPASTICITY AND CONTRACTURES – ACTOR

Van de Perre L. [1], Sevit R. [1], Janssens K[1], Peeraer L. [1]

[1] MOBILAB, K.H.Kempen, Geel, Belgium

Background:

During the project ACTOR an active orthosis to control spasticity and prevent contractures at the elbow joint in patients with stroke is developed.

With an annual incidence of 200 to 300 per 100.000 inhabitants, stroke is the commonest cause of severe disability in Western countries.[1] 80% to 95% of patients with stroke do not show complete functional recovery of the hemiplegic arm and 38% of the patients develop spasticity in the first year.[2,3] In addition to pain and contractures, spasticity is a major barrier for efficient rehabilitation and has an unfavourable impact on numerous activities of daily life. The increasing amount of patients and the relative decrease of therapists create a need for technological innovations compensating this imbalance and resulting in an increase in therapy time, repetitions and task specificity.[4]

Aim:

The project ACTOR examines how an active assisted angular mobilisation therapy can be performed in an autonomous working system.

Methods:

EMG signals from m. biceps brachii and m. triceps brachii are used as input signals for the actuator control algorithm to guide the elbow flexion and extension movement, respectively. For each patient, an EMG threshold is defined that has to be exceeded during the whole range of motion (ROM) in order that the device assists the movement at a constant speed (10°/sec). In this way, active training of the patient can be ensured and, by increasing the threshold, training progression can be made. The ROM during this therapy is based on the passive ROM measured by a therapist. After proving the feasibility, the effectiveness of the device will be assessed by means of a clinical trial in which the effect on spasticity, active and passive ROM, muscle force and functional activities is investigated.

Conclusion:

This project will lead to a prototype preceding the development of a user-friendly, comfortable, safe and affordable rehabilitation device. Future potential can lie in the possibility to become a complement to traditional, labour- and time-intensive neurological rehabilitation to achieve a faster functional recovery of patients with stroke.

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2. FEASIBILITY OF TECHNOLOGY-ASSISTED TASK-ORIENTED SKILL TRAINING IN SPINAL CORD INJURY

Spooren A.[1,2] , Vanmulken D.[2,3], Bongers H.[3], Seelen H[1,2], Timmermans A[1,2]

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[2] Maastricht University, Research School CAPHRI, Department of Rehabilitation Medicine, Maastricht, The Netherlands

[3] Adelante Rehabilitation Centre, Hoensbroek, The Netherlands

Background/aim:

For patients with cervical spinal cord injury (C-SCI) a task-oriented client-centered upper skilled training (ToCUEST) was developed and proven beneficial, but little experience with task-oriented technology-assisted training is available in C-SCI. For stroke patients, a Technology-assisted Task-Oriented-Arm-training concept (T-TOAT) was developed to improve upper extremity functioning, which may be used in combination with the Haptic Master robot (HM). This study aims to assess the feasibility of the T-TOAT training with the HM in C-SCI persons.

Methods:

A pilot-study in which C-SCI patients, who have finished rehabilitation more than one year ago, were trained with the HM for 6 weeks. The training system consisted of 1)a computer-screen and PC, 2) video-instructions of a tailor-made arm-hand training , 3) Haptic TOAT software and 4)a HM robot that may assist the patient's arm movement. Measurements were taken before training, after 4 weeks of training and after the training stopped.

Results:

5 C-SCI patients participated (mean age: 47 year; 3 ASIA Impairment Scale(AIS) AB, 2 AIS CD; lesion level between C5 and C7). No significant progress was demonstrated at the ICF function level (measured by the Microfet) and ICF activity level (measured by the Van Lieshout Test and the Spinal Cord Independence Measure). Patients scored the credibility better than the expectancy (mean item-score on Credibility and Expectancy Questionnaire 6.6 and 4.3 out of 9 respectively. All items of the Intrinsic Motivational Inventory scored more than the neutral score of 3.5, with the exception of the pressure/tension item (mean of 1.5 out of 7). System usability was rated to be moderate (mean of 4.7 out of 7 on USE).

Conclusion:

It is feasible to train C-SCI persons with the HM. Further research is needed to assess in which group of C-SCI and in which stage of the rehabilitation HM training is most beneficial.

3. TRANSFER OF MOTOR LEARNING IN (ROBOTIC) TASK-ORIENTED ARM-HAND TRAINING AFTER STROKE

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[3] Maastricht University Medical Centre, Department of Rehabilitation Medicine, Maastricht, the Netherlands

Background and aims:

Impairment of arm-hand performance after stroke severely affects activities of daily living. Technology-supported rehabilitation is a promising tool for improving arm-hand performance in chronic stroke patients. Besides the task-specific learning process, the ability to transfer acquired arm-hand performance from trained skills to other (untrained) skills and situations is very important. The aim of this study was to examine to what extent transfer of arm-hand skilled performance occurred after task-oriented training of 2-4 skills to untrained skills, and whether or not transfer effects differed between technology-supported task-oriented arm-hand training and non-technology supported task-oriented arm-hand training.

Methods:

Twenty-two chronic stroke patients (mean age 59 year; mean time post-stroke 3.3 years) participated in a single-blind, randomized controlled trial. Both groups received intensive task-oriented arm-hand training (2x30min/day, 4 days/week, 8 weeks). The use of technology (Haptic Master) during training was the only difference between the intervention group (HMG) and control group (CG). The Motor Activity Log (MAL), consisting of an amount of use scale (AOU) and quality of use scale (QOU), was used to determine the improvement on untrained tasks. Data analysis included the Mann Whitney Test.

Results:

Transfer of motor learning occurred in both groups. The HMG improved for the AOU scale on 29% of the untrained tasks and for the QOU scale on 38% of the untrained tasks, reported by the MAL. The CG improved on 29% of the untrained tasks (AOU scale) and 50% of the untrained tasks (QOU scale). The mean improvement in score for untrained tasks was 67% (AOU) and 45% (QOU) for the HMG and 62% (AOU) and 41% (QOU) for the CG. No significant differences between groups were found.

Conclusions:

Transfer of motor learning occurred in both groups. This may be attributable to the task-oriented training approach, applied in both groups.

4. COMPUTERIZED AIMING TASK TO ASSESS SENSORIMOTOR IMPAIRMENT IN CHRONIC STROKE

Timmermans A.[1,2], Lemmens R.[1,2], Adam J.[3], Geers R.[1], van den Borne J.[4], Seelen H.[1,2]

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[4] Adelante Rehabilitation Centre, Hoensbroek, the Netherlands

Introduction:

Computer-assisted assessment of arm-hand-function (AHF) after stroke is gaining interest. Fitts' law describes movement in human-computer interaction as the relation between movement time and movement difficulty. However, it is unclear to what extent Fitts' law is sensitive to severity of sensorimotor impairment in stroke.

Aim :

To assess the relation between Fitts' law and AHF impairment in stroke.

Patients:

Sixteen chronic stroke patients ((M/F=11/5); mean age: 58.8yr (sd=7.0)) participated.

Methods:

Design: Cross-sectional study. Subjects performed a uni-manual pointing task, involving the affected arm. Movement direction, distance and target width were systematically varied across 160 attempts. From these parameters the index-of-difficulty was calculated. Reaction time, movement time and movement errors were recorded. Linear regression analyses between movement time and index-of-difficulty produced 2 parameters: regression angle (A) and error estimate of the regression model (RMSerror). Both parameters are presumed to be associated with (cerebral) motor impairment in stroke. Correlations between A, RMSerror and Fugl-Meyer test (FM) were calculated.

Results:

Mean values of A, RMSerror and FM were 0.137rad (sd=0.142), 311ms (sd=189) and 53.6 (sd=7.6) respectively. Correlation coefficients between A and FM, and RMSerror with FM were -0.432 (p=0.095), and -0.648 (p=0.007) respectively.

Conclusion:s

A strong inverse relation exists especially between RMSerror, calculated from Fitts' model, and FM, indicating that less error is associated with better AHF in chronic stroke. The reliability of the Fitts' test and its sensitivity-to-change, i.e. its ability to detect (clinically significant) differences between conditions, still have to be investigated.
First indications suggest that the Fitts' test can be developed into a valid (and possibly sensitive), easy to use instrument to assess arm-hand-function impairment levels in stroke patients.

5. REPEATABILITY OF A THREE-DIMENSIONAL SCAPULAR MOVEMENT ANALYSIS IN PERSONS AFTER STROKE

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[2] BIOMED Biomedical Research Institute, Universiteit Hasselt, Diepenbeek, Belgium

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[4] Clinical Motion Analysis Laboratory, University Hospital, Pellenberg, Belgium

Background and aim(s):

Three-dimensional movement analysis (3DMA) is a powerful tool providing objective information on joint motion. This pilot study investigated the repeatability of scapular 3DMA in stroke patients.

Methods:

Scapular motion at the hemiplegic (HS) and non-hemiplegic side (NHS) of 7 stroke patients was assessed twice, during frontal (EF) and sagittal (ES) plane elevation (0-60°, 0-120°). Ten retroreflective markers were placed on the trunk, scapula and humerus. Scapular bony landmarks were palpated and digitized during static trials (CAST-method) [1], anatomical coordinate systems were defined following the ISB [2]. Waveform similarity was assessed with the coefficient of multiple correlation.

Result(s):

0°-120°: *Within session repeatability* was excellent (>0.90) for all scapular rotations for EF and ES (HS and NHS). *Between sessions repeatability* was excellent for scapular upward rotation for both tasks, on both sides. ES resulted in good (0.80-0.89) repeatability for protraction (both sides), while protraction was moderately (HS) (0.60-0.79) to poorly (NHS) (<0.60) repeatable for EF. Scapular tilt was excellently repeatable during both tasks on the NHS, though only poorly (EF) to moderately (ES) repeatable on the HS.

0°-60°: *Within session repeatability* was excellent for all scapular rotations for both tasks on the NHS and during ES on the HS. EF on the HS resulted in an excellently repeatable upward rotation, and moderately repeatable protraction and tilt. *Between sessions* protraction and tilt were poorly (EF) to moderately (ES) repeatable (both sides), while upward rotation resulted in moderate to good repeatability.

Conclusion(s):

Since low repeatability is dependent of plane and degree of elevation, considerations on the movement protocol should be made. Additional tasks should be added and tested for repeatability. Optimization of standardization procedures might be required to maximize repeatability, especially between the sessions.

References

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6. 'REAL-LIFE' USE OF THE UPPER LIMB IN MULTIPLE SCLEROSIS: RELATIONSHIP WITH CLINICAL OUTCOME MEASURES

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Background and aim(s):

The aim is to investigate in a group of persons with MS (PwMS) the relationship between the real-life use of the upper limb objectively measured by motionloggers and different subjective and capacity outcome measurements of the ICF. The impact of upper limb dysfunction is poorly documented in PwMS. However the upper limbs plays an important role in the accomplishment of many daily activities. More insights are needed regarding the use and functioning of the upper limbs in the daily living in PwMS, and related outcome measures.

Methods:

In this ongoing study, 15 PwMS with unilateral or bilateral upper limb dysfunction due to muscle weakness are included so far. The clinical outcome measurements on different levels of the ICF were the Motricity Index (MI), Jamar, Brunnstrom Fugl Meyer (BFM), Action Research Arm test (ARAT) and the nine hole peg test (9HPT) as well as an adapted version of the Motor Activity Log (MAL). The motionloggers of AMI inc. (Ardsley, New York) were used to objectively measure the 'real life' use of the upper limb. They were attached for 1 week to the wrist of both hands. The output of the motionloggers is the Proportional Integration Measure (PIM). The PIM is a measure of activity level of motion.
Spearman rank order correlation coefficients were used to quantity the relationship between the motion loggers and the different outcome measurements. Multiple regression analyses with motion loggers as dependent and the clinical outcome measures as independent variables will be carried out when data of a larger sample are available.

Result(s):

The preliminary results in 15 persons indicate that, for the dominant hand, moderate to high correlations were found between the motionloggers (PIM) and the BFM (r=0,633), MAL (r=0,769), MI (r= 0,768) and Jamar (r=0,803). No significant correlations were found with the ARAT and NHPT. For the non-dominant hand, all correlations were remarkably higher compared to the dominant hand with the highest correlation found with MAL (r=0,818).

Conclusions:

For both hands, the highest correlations were found between the motionloggers and the measurements on function level: MI, Jamar and BFM. The preliminary results also suggest that the MAL, a subjective measurement of upper limb use during performing ADL is well correlated with the motionloggers, an objective measurement of real-life use of the upper limbs. This finding suggest that measurements on the function level provide better representation of the upper limb use in daily living than measurements at activity level.

7. MMAAS - MOTION AND MUSCLE AMBULATORY ACTIVITY SYSTEM

Alessio Murgia[1], Vincent Kerkhofs[2], Hans Savelberg[1], Kenneth Meijer[1]

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[2]Instrument Development Engineering & Evaluation (IDEE) Department, Maastricht University, Maastricht, The Netherlands

The MMAAS is a device for recording and analyzing upper limb movements and muscle activities in a single product. The device's outputs are related to aspects of clinical assessment such as joint coordination, fatigue and muscle synergies. We present the development of the MMAAS, its software interface and data from its use on healthy subjects and multiple sclerosis subjects for the purpose of monitoring upper limb movements.

8. A PORTABLE DEVICE FOR THE CLINICAL ASSESSMENT OF UPPER LIMB MOTION AND MUSCLE SYNERGIES

Alessio Murgia[1], Vincent Kerkhofs[2], Hans Savelberg[1], Kenneth Meijer[1]

[1] Department of Human Movement Sciences, Maastricht University Medical Centre + (MUMC+), Maastricht University, Maastricht, The Netherlands

[2]Instrument Development Engineering & Evaluation (IDEE) Department, Maastricht University, Maastricht, The Netherlands

We present a device for recording and analyzing upper limb movements and muscle activities in a single unit.
The device's outputs are related to aspects of clinical assessment such as joint coordination, fatigue and muscle synergies. A comparison with an optoelectronic motion capture system was also carried out during a hand to mouth and a hand to contralateral shoulder task.
High correlation was found for the elbow angles, while analysis of the root mean square errors indicated that the angular outputs of the device were overestimated compared to the angles calculated using the optoelectronic system. Biceps and triceps co-contraction patterns were also observed during the hand to mouth task. Applications to the clinical assessment and monitoring of neurological disorders are discussed.

9. McARM: MOTION CONTROLLED ARM SUPPORT

Loek van der Heide[1], Gert Jan Gelderblom, Luc de Witte

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Figure 1: Artist impression McARM

Purpose:

Decreased arm function in neuromuscular diseases (NMD) and progressive neurological disorders can lead to a limited ability to perform Activities of Daily Living (ADL) tasks and influences independency negatively. Arm supports are dynamic assistive devices supporting the users' arm against gravity and therefore enabling ADL performance. Existing arm supports can offer improvement but still have shortcomings in ADL performance, they are mainly passive or need to be actively controlled. The McARM project will develop an innovative arm support which is not only active but is also controlled through intuitive force exertion (minimal arm movements). For this, the remaining movement potential of the user is used through a haptic interface. Besides the use of the system as assistive device the new system offers training capacities. Individuals with impaired arm function, for example post stroke patients, can use the system to support restoration of arm function through dedicated training in addition to intensive therapy. The haptic interface provides high level feedback on the movement of the user and therewith on the required nature of training. It also allows for monitoring of progress.

Methods:

The project started in 2011 and at the end of the project (2014) McArm will have been developed. Market introduction will be aimed for after project completion. Potential target groups will be identified and specific requirements will be deduced from two systematic literature reviews and interviews and observations with current arm support users. Subsequent, collected functional requirements will be translated into technical specifications and a market research will be performed. Based on the results of the preceding phase, concepts will be developed and tested. The last two phases comprise the production and evaluation of the developed McArm through technical tests, lab-tests and real-life tests to determine whether the functional requirements are met, which may lead to corrections in the functional specifications. The last phase focuses on practical implementation of the developed arm supports. This will include the exploration of market introduction and the development of an advise protocol in close cooperation with Focal Meditech, market leader on arm supports in Europe.

Progress:

Two systematic literature reviews are in progress, one to gain insight in the effects of arm supports on ADL performance and one on the effects of training-specific arm supports on arm function. Six arm support users and three robotic manipulator users were interviewed on their ability to perform ADL task by means of a semi-structured interview (life-habits)1. Additionally, they were questioned about the importance of the specific tasks. Execution of six common ADL tasks was assessed by an occupational therapist. During both the interview and the observations, subjects were encouraged to explain the nature and origin of difficulties identified. This narrative was recorded and transcribed and will be quali-tatively analyzed.

References

1. Fougeyrollas. P, Noreau, L. "Assessment of life-habits General long form V.3.0". Quebec, Canada INDCP, 2003.

McARM is in part funded by the Dutch Pieken in de Delta programme and provincial co-funding by Limburg and Noord Brabant

10. FACILITATING ROBOT-ASSISTED TRAINING IN MS PATIENTS WITH ARM PARESIS

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Gravity compensation (GC) of the arm is used to facilitate arm movements in conventional therapy as well as in robot-assisted rehabilitation of neurologically impaired persons. Positive effects of GC on Range of Motion (ROM) have been demonstrated in stroke. In Multiple Sclerosis (MS), research regarding this topic is lacking. Since an active participation of the patient is required for effective training, full support of the arm might not be advisable. The present study reports on the development of a procedure to measure actively the individual need for GC and to estimate the influence of GC on ROM during reaching, lifting and transporting in severely affected Persons with MS (PwMS). Ten PwMS were tested with the procedure for determination of GC. Maximal reaching movements were performed in a 3D space in three conditions: No support (NS), with GC by the HapticMaster (GC-HM) and with GC by the HapticMaster combined with a sling suspension system (GC-HMS). For the total sample, significant correlations were found between the amount of GC and clinical tests for upper limb function. In four subjects with severe arm dysfunction it was found that mean ROM is larger in the GC-HMS condition compared to the GC-HM condition, and in the GC-HM condition compared to the NS condition, suggesting positive effects of GC on active ROM in PwMS. Therefore, GC could have a positive effect on arm rehabilitation by enabling the PwMS to actively reach a larger ROM during training.

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Financiering

Interreg Vlaanderen-Nederland

Europese Unie, EFRO

Vlaamse Overheid

Nederlandse Overheid

Provincie Limburg (B)

Provincie Limburg (NL)

Provincie Vlaams-Brabant (B)

Provincie Noord-Brabant (NL)