Information technologies for rehabilitation

Lecture
CO74-001-e
Robotic systems for motor neurophysiology: From the neural control of movement to neuromotor rehabilitation
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Robotic haptic interfaces have been used since the mid 1980s for characterizing the mechanical impedance of the upper limb, thus, highlighting the strong degree of anisotropy of the musculoskeletal system, which contrasts with the apparent “Cartesian” isotropy of hand trajectories. In this context, it came to the fore the concept of internal control model, namely the idea that the brain must be able to develop/learn computational representations of the body dynamics and of the interactions of the body with the outside world. However, it is difficult to study experimentally such spontaneous process and thus, the next logical step was to exploit the same haptic robots also for generating artificial dynamic environments that allow controlled experimental analysis of such process. This is a necessary prerequisite for a rational introduction of robotized haptic interaction in the field of neuromotor rehabilitation, which we suggest to address as a process of training the subjects to reconstruct/repair the internal control models, damaged by pathological processes. A logical consequence is to conceive the rehabilitation robot more as a cybernetic device for facilitating sensorimotor learning rather than a mechatronic system aimed at purely passive handling. This means, in particular, that the robot must be designed and controlled in such a way to integrate quantitative measurements with motor actions and must interact with subjects in a bi-directional way. Robot technology in rehabilitation is promising but its rational use requires a better common understanding between physiatrists and physiotherapists, on one side, and robot engineers, on the other.

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Oral communications

CO74-002-e
Driving fitness assessment in Portugal
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Introduction.– Many conditions may impair the ability to safely operate a motor vehicle. Driving competence assessment is very important to grant road security. Sometimes it’s even necessary to make some vehicle adaptations. In Portugal, there is only one driving simulator, which is located in Rehabilitation Medicine Centre of Alcoitão. This study aims to disclose the evaluation methods used in this centre.

Material and methods.– Data was collected from driving fitness assessment reports from June 2007 to December 2013. Characterization of reports was undertaken with regard to the patient (demographics, diagnosis and disability) and the result (fit with/without adaptation(s) or unfit). Some considerations were made about the results founded.

Results.– Since the installation of the actual simulator more than 1100 exams were performed. A total of 73% of the patients were men and 84% had license to drive previously. The major cause of disability was stroke. Then, 66% were considered fit to drive with adaptations and 10% were considered unfit to drive, mainly because motor/mental impairment.

Discussion.– Driving ability results not only from the integrity of motor and mental skills, but also from good vision and hearing. Driving fitness assessment is necessary whenever there are doubts about patients’ capabilities - these may change over time.

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CO74-003-e
Telerehabilitation of manual dexterity: A pilot study
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Introduction.– Distant technologies allow rehabilitation of non-mobile patients and patients living in distant locations. The study was aimed to develop a technique of manual dexterity telerehabilitation.

Methods.– Five patients with stroke, TBI, spinal trauma aged 45.3 ± 12.5 years were included into the study. Distant assessment of manual dexterity included Disabilities of the Arm, Shoulder and Hand (DASH) scale rating with the use of Scopia teleconference system and measurement of the range of motions with HandTutor. Telerehabilitation included individual exercise therapy and training with HandTutor biofeedback glove. The software was installed to patients personal PC by the use of TeamViewer. Program lasted 3 weeks to 4 months.

Results.– Compliance was high in all participants. Equipment adjustment and instructing the patients on its use took 1–3 sessions. After this period, all the patients were able to use the system on their own according to therapeutic plan. All the technical problems were solved distantly. After telerehabilitation course, DASH score decreased from 72.1 ± 14.3 to 55.7 ± 13.2 (P = 0.03), range of

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motion increased from 11.3 ± 9.5 to 16 ± 10.1 (P = 0.04). Participants reported high satisfaction with the program.

Discussion.— The developed telerehabilitation program is an accessible alternative to in-hospital and outpatient training and allows high-tech rehabilitation at any location.

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Performance analysis of adults with acquired brain injury making errands in a virtual supermarket
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Objective.— To explore the links between patients’ performance, daily life integration and a battery of neuropsychological tests.

Method.— A Principal Component Analysis (PCA) was performed for 50 subjects among 95 including the whole neuropsychological battery, community integration questionnaire and performance in the VAPS. The PCA raises four components that explain 70% of the total variance. These factors show that the dynamic performance in the VAPS can’t be only explained by executive functioning.

Conclusion.— A virtual environment like VAPS simulating an activity of daily living quickly raises through functional performance numerous pieces of information about presence and impact of neuropsychological diseases in daily life.

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CO74-005-e
Evaluating efficacy and users’ expectations of a virtual reality training system: A multicenter randomized controlled trial

Objective.— The aim of this study is the evaluation of an intensive VR training system compared to conventional occupational or physiotherapy treatment in a multicentre setting with three participating centres.

Methods.— Based on power calculation, 60 stroke patients will be randomly allocated to an experimental VR (EG) or a conventional therapy (16 sessions, 45 minutes each) control group (CG). Patients manipulate virtual objects and environment in real time. Blinded assessors test patients’ motor and cognitive performance five times during the trial using a set of standardized stroke assessment for motor control, activity and participation.

Results.— Therapists in all centres completed the study training. Patients are being recruited. Until now, 18 of 21 screened patients were eligible for inclusion, tested and randomized (1:1 ratio) to either EG (n = 9) or CG (n = 9); 5 females, 6 x right side affected, age ranged between 20–76 years, mean 61.5 years; time since stroke 0.5–10 years, mean 3.3 years.

Discussion.— The study protocol seems to be feasible and patients enjoy VR training. The staffs in all centres are highly motivated and ensure high ethical and research standards. This CTI sponsored trial is on time in its schedule and registered with clinicaltrials.gov: NCT01774669.

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Posters

P484-e
Serious games and rehabilitation
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Keywords: Serious games; Virtual reality; Rehabilitation; Handisport

Introduction.— An efficient tool was developed in order to quantify and improve cognitive and physical capabilities of a disabled person using the concept of Serious Games.

Methods.— The system uses a computer and a sensor games (WHIMOTE or KINECT). Three serious games have been developed for people with motor disabilities.

Method.— The disabled patient is placed in a virtual reality environment in order to practice a chosen game. In applying the guidelines of the therapist and/or trainer (in the case of Handisport), a real-time tracking of his gestural activity is obtained.

Results.— Three serious games have been developed (handi-bowling, handi-curling, and handi-bowls). The acquisition movements and data processing are performed in real time. At the end of each sequence, the patient (or the player) and the therapist (or coach) obtain the results in the form of curves, tables… Their exploitation is used to analyse and quantify a gesture to be corrected and improved.

Discussion.— Serious games can offer a wide range of innovations in opening new perspectives in the field of rehabilitation.

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P485-e
Virtual reality exposure therapy in post-traumatic stress disorder: Developing new opportunities of rehabilitation of post-fall syndrome in elderly subjects
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Keywords: Virtual reality; Post-fall syndrome; Elderly subjects

Introduction.— We showed in a monocenter prospective survey that about 30% of elderly subjects after a fall showed post-traumatic stress disorder (PTSD) symptoms at 2 months. Since it has been shown that virtual reality...