CO11-001-e
Inferences on the role of proprioception for perception and action by studying deafferented patients
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Proprioception, the sense of position and movement of body segments, may not be known as much as other senses such as vision or audition. However, since the pioneer work of Sherrington, the critical role of proprioception in motor control has been increasingly highlighted. In particular, studies of human subjects massively deprived of proprioception after a viral infection, have largely demonstrated their inability to coordinate their actions. As this typically results in an inability to stand and walk, we focus here on the ability of deafferented patients to control their upper-limb movements. We will first present studies that provided striking evidence for the role of proprioception in movement coordination before presenting our recent work on the role of proprioception in motor learning and how the loss of large somatosensory fibres may affect visual perception.

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Neuromuscular reorganization after arm amputation revealed by stump EMG evoked by different phantom movements
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Keywords: Stroke; Motor control; Augmented feedback; Motor learning; Sonification

Introduction. Following stroke, patients frequently demonstrate loss of motor control and function and altered kinematics of reaching movements (decreased velocity, loss of smoothness and loss of inter-joint coordination). Recent clinical observations using rehabilitation technology suggest that active training may reduce impairment thanks to motor learning. One method to promote motor learning is movement sonification. In this framework, we are exploring the poten-
tial of augmented auditory feedback as a means to guide movement performance during training (Knowledge of Performance) and not, as is usually done, simply to signal the success of the trial (Knowledge of Results).

Material and methods.– Sonification of arm movement can provide patients with auditory feedback relative to the ongoing direction of the movement, coordination between shoulder and elbow movement and/or motion smoothness. This implies the online recording of the movement and quantifying of the related impairment in order to generate feedback which stimulates appropriate audio-motor coupling.

Results.– We present a literature review of previous pilot studies of sonification for motor rehabilitation and our current exploration involving different types of sonification and musical metaphors usable in rehabilitation (including source-filters, concatenative/granular synthesis and physical model sound synthesis).

Conclusion.– The perspective of sonification for rehabilitation will be discussed.

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Upper arm of stroke patients: From kinematics recording to rehabilitation

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Objectives.– Kinematics analysis allows quantitative and qualitative assessment of motor function of the upper limb. This method allows the recording of sensorimotor markers that can be used in rehabilitation to adapt the difficulty of the exercises applied to patients after stroke.

Patients and methods.– Three successive studies conducted between 2011 and 2013 will be summarized. These studies rely on kinematics motion analysis through electromagnetic sensors.

Results.– A first study of 13 hemiplegic patients in the initial phase of recovery has established the correlation between kinematics parameters and clinical scores. A second study conducted with 13 hemiparetic subjects and 12 healthy controls aimed to measure the anisotropy of the peri-personal space during pointing tasks. A third preliminary study focused on the interest of the use of kinematics data acquired during a video game session in seven stroke patients, in order to design difficulty self-adaptation software modules to automatically upgrade the difficulty of the game.

Discussion.– These results confirm the importance of translational research involving researchers in the field of motor control and rehabilitation professionals.

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Keywords: Stroke; Upper arm; Kinematics analysis; Rehabilitation; Video games