

RAVE-08 Abstract

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The Rehabilitation Gaming System and its main properties in stroke rehabilitation: inducing functional neuronal reorganization through action observation

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Abstract

In the last few years several Virtual Reality (VR) systems have been proposed for motor rehabilitation following stroke. There is strong evidence that such systems have a positive impact on the recovery of motor function. Such augmented feedback systems in theory allow us to define optimal stimulation conditions for neuronal reorganization and rescue in the context of rehabilitation and training. As an empirical validation of this approach we have developed the Rehabilitation Gaming System (RGS). We have chosen as a first approach the rehabilitation of motor deficits of the upper limbs following stroke. In the RGS arm movements are tracked by means of a video based motion tracking system; through a biomechanical model, movement data is mapped onto the movements of virtual limbs that thus mimic the movements of the user, in a first person perspective. The RGS upper extremity rehabilitation scenario consists of multiple tasks with graded difficulty and specificity: a 'Hitting' task to train range of movement and speed; a 'Grasping' task to train finger flexure; and finally a 'Placing' task to train grasp, release and displacement. The core hypothesis underlying RGS is that through the visual presentation of virtual limbs that are strongly coupled to the movement intent of the patient, we can recruit the action recognition or mirror neuron system, and through these provide direct stimulation of motor areas affected by the stroke. The mirror neurons discharge both during goal oriented action execution and observation of the same action when performed by others. We directly evaluate the hypothesis that this novel approach will speed-up and enhance recovery following stroke by both allowing reorganization and recovery of lost function and by promoting rescue of neuronal systems that are structurally intact.

Here we show that our system retrieves quantitative information that allows detailed assessment of a patient's deficits providing a tool for diagnostics and monitoring. Moreover, we show that the movement deficits are transferred from real to virtual tasks, indicating that while performing within the virtual environment the main properties of the movement are preserved. We will also report on our initial results with the clinical impact study of the RGS with acute stroke patients in a controlled randomized study. More specifically, we will discuss the quantitative longitudinal impact of our system, the validity of our underlying hypotheses, and the relationship between the patient's profile and their recovery dynamics.