EEG-based "walking" of a tetraplegic in virtual reality

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INTRODUCTION

Virtual reality allows patients to perform movements in a safe environment. In this case study a tetraplegic patient is able to control movements of his wheelchair within virtual reality by self-paced motor imagery using an EEG-based BCI. The task of the subject was to "walk" to the end of a street by imagining movement of his paralyzed feet.

METHODS

A high spinal cord injured tetraplegic patient was able to generate bursts of beta oscillations in the EEG by imagination of foot movements [1]. Only one single EEG channel was analyzed and classified sample-by-sample by a Brain-Computer Interface (BCI) and used asynchronously to control a virtual environment (VE). The used VE was a virtual street populated with 15 avatars [2]. The patient was placed with his wheelchair in the middle of a 4-wall-projection CAVE and his task was to "walk" towards the end of the virtual street by movement imagination of his paralyzed feet. Every time he was passing by an avatar he had to stop very close to it. The avatar started talking to the patient if he was standing still for one second. After a while, by free will, the subject could imagine the next foot movement and started walking again, till the end of the street was reached.

RESULTS

The patient was able in six runs to stop at 88% of the 90 avatars and talked to them. In an interview the patient confirmed that "walking" occurred only during periods of foot motor imagery (15.7% of the run time), but he reported that it was hard to stop precisely.

DISCUSSION

It could be demonstrated for the first time that a tetraplegic patient in a wheelchair could control his movements by the usage of a BCI based on one single EEG recording. Controlling a VE (e.g. the virtual street) is the closest possible scenario to controlling the real wheelchair in a real street. Virtual reality provides an excellent training and testing environment without risks for future rehabilitation procedures.

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References

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