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Camille Jeunet, project-Team Hybrid - Inria Rennes Bretagne Atlantique

Title: « Using ElectroEncephaloGraphy (EEG) and Virtual Reality (VR) to understand and improve cognitive performance »

Abstract:
During this presentation I will introduce two projects the goal of which is to understand and improve cognitive performance using EEG and VR. The first project was dedicated to acquiring a better understanding of users' sense of agency (i.e., the fact of feeling in control) in virtual environment. Indeed, this sense of agency is related to the feeling of immersion and presence and thus has a great impact on the perception and interaction in VR.
Therefore, it is important to understand the factors influencing the sense of agency in order to design appropriate virtual environments. We proposed novel approaches to characterise, manipulate and measure the sense of agency in VR. Our user experiments enabled us to validate our approach and to reveal EEG markers of the sense of agency.
The objective of the second project is to design neurofeedback protocols based on VR to improve soccer goalkeepers' performance. More specifically, we chose to focus on one cognitive ability of utmost importance for these athletes: covert attention (i.e., the ability to allocate attentional abilities to objects located in our peripheric field of view). We recorded the EEG activity of goalkeepers with different expertise levels in the aim to determine (1) if covert attention was underlain by neurophysiological correlates that we can measure using EEG and (2) if these correlates were related to athletes' expertise. Once the relationship between the marker and the expertise established, it will be possible to train goalkeepers to modulate their brain-activity (using neurofeedback) in order to obtain the same neurophysiological patterns as the expert athletes. Our hypothesis is that such a neurofeedback training procedure, based on VR to provide ecological conditions, could enable the goalkeepers to improve their cognitive abilities (covert attention abilities) and potentially their performance on the field.