PhD Thesis : 3D Interaction with Video Games Based on Brain-Computer Interfaces

Keywords : Brain-Computer Interfaces, Video Game, Virtual Reality, 3D Interaction, Interaction techniques, ElectroEncephaloGraphy

Laboratory : INRIA, Bunraku research team, Rennes, France

Supervisor : Dr. Anatole Lécuyer – anatole.lecuyer@irisa.fr

Starting : Sept-Dec 2009

Salary : 1889,90 euros/month (before taxes)

DESCRIPTION

The objective of this PhD Thesis is to study the use of Brain-Computer Interfaces to interact with video games.

Brain-Computer Interfaces (or BCI) correspond to the direct use of brain signals to send "mental commands" to an automated system such as a robot, a prosthesis, or a cursor on a computer screen. Cerebral activity is measured through ElectroEncephaloGraphy (EEG), that is with electrodes located at the surface of the scalp and recording electrical signals emitted by the brain.

This PhD Thesis is in the frame of a 3-year collaborative project called “OpenViBE2” (2009-2012) involving 10 French partners (such as INRIA, INSERM, UBISOFT and CEA) and focusing on the use of Brain-Computer Interfaces for video games. It is also closely related to the development of the OpenViBE software (http://openvibe.inria.fr) - a free and open-source software platform dedicated to designing, testing and using brain-computer interfaces.

Brain-Computer Interfaces are no longer a dream today as several impressive prototypes have been developed in recent years. However, few laboratories have studied the integration of BCI with Virtual Reality technologies and with video games [Lécuyer et al., 2008]. In this PhD Thesis, the aim will be to design, develop and test new methods to improve the use of BCI to interact with virtual worlds. Novel interaction techniques will be proposed that concern one or several classical tasks operated in virtual environments such as: navigation in virtual world, selection and grasping of virtual objects, manipulation of virtual objects, or application control (menus, buttons, etc) - all these elementary tasks being achieved “by thought“. Experimentations are planned to evaluate and validate the developments and the approach using EEG acquisition machine.

Background

The successful candidate must have a Master in Computer Science, or Human-Computer Interface, or Virtual Reality, or Neuroscience, or Signal-Processing.
He/she must have good skills in programming (C/C++).
Knowledge/motivation in Neuroscience, Virtual Reality, Computer Graphics

Hardware/Software at disposal

EEG acquisition machines

REFERENCES

- OpenViBE website : http://openvibe.inria.fr
- A. Lécuyer, F. Lotte, R. Reilly, R. Leeb, M. Hirose, M. Slater, "Brain-Computer Interfaces, Virtual Reality, and Videogames", IEEE Computer, vol. 41, no. 10, pp 66-72, 2008
- J.B. Sauvan, A. Lécuyer, F. Lotte, G. Casiez, "A Performance Model of Selection Techniques for P300-Based Brain-Computer Interfaces", ACM SIGCHI Conference on Human Factors in Computing Systems (ACM CHI), 2009
- F. Lotte, "Study of Electroencephalographic Signal Processing and Classification Techniques towards the use of Brain-Computer Interfaces in Virtual Reality Applications", Thèse de Doctorat, INSA Rennes, 2008
- F. Lotte, Y. Renard, A. Lécuyer, "Self-paced Brain-Computer Interaction with Virtual Worlds: a Quantitative and Qualitative Study "Out of the Lab", 4th International Brain-Computer Interface Workshop and Training Course, 2008, pp. 373-378