Research Topic 29 for the ParisTech/CSC PhD Program

FOR APPLICATION, PLEASE CONTACT ADVISOR(S) BY EMAIL WITH COPY TO:
ali.siadat@ensam.eu AND yvon.velot@ensam.eu

Subfield: Neuroscience functional
ParisTech School: Arts et Métiers

Title: "Measuring the viewer experience in Virtual Reality"
Advisor(s):
Pierre-Paul VIDAL pierre-paul.vidal@parisdescartes.fr http://www.biomedicale.parisdescartes.fr/~cognac/cognac/
Sébastien LAPORTE sebastien.laporte@ensam.eu http://biomecanique.ensam.eu/

Short description of possible research topics for a PhD:
Immersive systems such as flight simulators or virtual reality (VR) games do not provide any measurement of the user's personal experience. Yet, these data may help to improve the interface's design, the training, and the user's physical safety. In addition, while VR is getting more immersive, the influence and limits of these devices on users' cognition are not known yet. The user's personal experience can be appreciated in several ways that is in terms of mental workload, stress and emotion. On the one hand, mental workload can be defined as the portion of operator information processing capacity or resources that is actually required to meet system demands i.e. as a capacity. On the other hand, emotion can be seen as the interface between an organism and its environment, mediating between constantly changing situations and events and the individual's behavioural responses i.e. a type of sensation. In that context, the physiological events we can measure in response to VR experience need to be accurately interpreted. This is not an easy task. Fear is one of the basic emotions that can be distinguished with autonomic nervous system activity. However, fear has not a unique and invariant autonomic signature and so far there is no universal scaling of objective fear. The same can be said about stress and mental workload with similar attempts to use autonomic signatures and various tools such as double tasks. Therefore, several studies have assumed that the ground truth for fear, workload and stress was the subjects' personal evaluation. Altogether then, as fear presents some similarities with stress and workload in terms of physiological and psychological markers, the purpose of the present study is to try to tease apart these different factors affecting the VR user when experiencing different types of virtual environment including fearful games. In order to fulfil that objective, we intend to record in the VR viewers several physiological markers (heart rate and respiratory rate, skin conductance etc.), together with his/her vocalizations and motor activity and the scores when games are used. The motor activities will be recorded with a Coda motion system allowing quantifying movement using up to 25 markers. In addition the subjects will be asked to answer several questionnaires to estimate their subjective experience. One of the difficulty of the intended study is to record synchronously during the VR experience several visual markers, the recordings of the physiological markers and the voice and the motor recordings. However, thanks to a long collaboration with Thales Training Simulation, we believe we can now meet this difficult and exciting challenge.

Required background of the student:
Master 2 in Neurosciences/Biomechanics.

A list of 5 (max.) representative publications of the group:
- S Laporte, D Wang, J Lecompte, S Blancho, B Sandoz, A Feydy, P Lindberg, J Adrian, E Chiarovano, C De Waele, P.-P. Vidal , An attempt of early detection of poor outcome after whiplash, Frontiers in Neurology 2017
- R. Barrois, T Gregory L. Oudre, J. Audiffren, T. Moreau, C Truong, A. Aram Pulini, S. Buffat, A. Yelnik, N.Vayatis, C. de Waele, S. Laporte, phd, N. Vayatis, P.-P. Vidal, D. Ricard. An automated recording method in clinical consultation to rate the limp in lower limb osteoarthritis. PLoS One 2016
- I.S. Curthoys, H.G. MacDougall, P.-P. Vidal, C. De Waele. Sustained and transient vestibular responses : a physiological basis for interpreting vestibular function. Front Neurol. 2017
- Barrois R, Ricard D, Oudre L, Tlili L, Provost C, Vienne A, Vidal PP, Buffat S., Yelnik A. Observational study of 180° turning strategies using inertial measurement units and fall risk in post-stroke hemiparetic patients. Front Neurol. 2017
- Vienne A, Barrois R, Buffat S., Ricard D, Vidal PP . Inertial sensors to assess gait quality in patients with neurological disorders: a systematic review of technical and analytical challenges. Front Psychol. 2017