

## Research Topic for the Arts et Métiers ParisTech - CSC PhD Program

**Subfield:** Virtual reality, computer science

**ParisTech School:** Arts et Métiers ParisTech (ENSAM)

**Title:** Natural multimodal collaboration in mixed reality

**Advisor(s):** Pr. Frédéric MERIENNE ([frederic.merienne@ensam.eu](mailto:frederic.merienne@ensam.eu)) and Dr. Jean-Rémy CHARDONNET ([jean-remy.chardonnet@ensam.eu](mailto:jean-remy.chardonnet@ensam.eu)) – Institut Image (<http://institutimage.ensam.eu/>)

Pr. Simon RICHIR ([simon.richir@ensam.eu](mailto:simon.richir@ensam.eu)) – LAMPA/Présence & Innovation (<http://www.laval.ensam.eu/>)

Dr. Jérôme PAILHES ([j.pailhes@i2m.u-bordeaux1.fr](mailto:j.pailhes@i2m.u-bordeaux1.fr)) – I2M (<http://i2m.u-bordeaux.fr/>)

### **Short description of possible research topics for a PhD:**

Nowadays it is quite common that different teams work from locations scattered around different cities or even countries. The purpose of this work is to analyze what are the main issues that should be taken into consideration while designing effective environments that foster the productivity of remote team work (session management for sequential analysis and concurrent analysis, communication among co-workers).

Traditionally, data analysis systems have been centered on visual data feedback. The reason for this is the high bandwidth of the human eye-brain link, and our ability to analyze visually complex patterns. Nevertheless, the increase on data complexity and the effects that boredom and fatigue have on human performance advice to complement the human visual channel with other sensory feedback, including the possibilities offered by haptic devices and 3D sound synthesis and reproduction. Work in this case will focus on the analysis of the features of modern haptic devices and audio synthesis systems for transferring information, the analysis of the cooperation vision-haptics-audio for enhanced information transmission in complex man-machine environments, the design of effective multimodal interaction metaphors for complex data (multidimensional, multimodal, multivariate), that are the most natural for the users (Natural User Collaboration).

When collaborating on complex data at remote sites, virtual reality facilities can be used (for instance, multitouch tables, CAVEs, head-mounted displays, etc.). However, it requires that each site has VR infrastructure. Recently new mobile technologies, such as smartphones and tablets, have been released to bring new insights to collaborative tasks and to enhance users' experience. Especially, augmented reality and the use of both virtual and augmented realities can be a promising field for collaborative tasks. Work in this case will focus on the analysis of collaboration using augmented reality and mixed reality, the design of effective interaction in mixed reality, a test of collaborative tasks in both in-situ and in-vivo sites on an industrial case.

**Required background of the student:** Computer science, mechanical engineering

### **2-3 representative publications of the group:**

[1] H. Hrimech, "Evaluation de métaphores d'interaction pour le travail collaboratif entre sites distants d'immersion virtuelle," Thèse de doctorat, Ecole Nationale Supérieure d'Arts et Métiers, Chalon-sur-Saône, France, 2009.

[2] H. Hrimech, L. Alem, and F. Merienne, "How 3D interaction metaphors affect user experience in collaborative virtual environment," Advances in Human-Computer Interaction, vol. 2011, pp. 230–241, 2011.

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