

## Research Topic 27 for the ParisTech/CSC PhD Program

FOR APPLICATION, PLEASE CONTACT ADVISOR(S) BY EMAIL WITH COPY TO:

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**Subfield:** Computer Science

**ParisTech School:** Ecole Nationale Supérieure d'Arts et Métiers ParisTech - ENSAM

**Title:** Interactive Augmented Reality Using Wearable Haptics Systems

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**Short description of possible research topics for a PhD:** (10-15 lines in English + optional figure)

Today, Augmented Reality applications are already very convincing; they are widespread in many fields, especially in medicine, Education, and Industry. However, users are still not able to physically interact with virtual objects, thus limiting their presence sensation. Wearable haptics can bridge this gap between digital and physical worlds and can provide the compelling illusion of touching superimposed virtual objects without constraining the motion or the workspace of the user. Integrating haptic devices in Augmented Reality Environments is a complex task that poses challenging issues such as haptic feedback, haptic augmentation, and real-virtual object interaction. The goal of this PhD proposal is to study these problems in order to develop a smart and efficient wearable haptics device that allows a user to naturally interact with virtual objects displayed through AR Glasses (e.g., Hololens). The project will focus on the development of direct touch solutions and their integration with see-through Augmented Reality. To this end, highly accurate calibration, system stability, and low latency are necessary. These points will also be tackled within this thesis.

**Required background of the student:** (Which should be the main field of study of the applicant before applying)

Applicants should have a Master degree or equivalent in a related discipline, such as software engineering, computer science, mechatronics, or a related field with programming skills, skills in electronics.

The ideal candidate should have some understanding in the area of virtual/augmented reality, computer vision, haptics, and simulation.

**A list of 5 (max.) representative publications of the group:** (Related to the research topic)

1. M. Maidi, F. Ababsa, M. Mallem, M. Preda: Hybrid tracking system for robust fiducials registration in augmented reality. *Signal, Image and Video Processing* 9(4): 831-849 (2015)
2. F. Ababsa, Imane M. Zendjebil, Jean-Yves Didier, Malik Mallem: Smart Localization Using a New Sensor Association Framework for Outdoor Augmented Reality Systems. *J. Robotics* 2012: 634758:1-634758:15 (2012)
3. J.-C. Léon, T. Dupeux, J.-R. Chardonnet, et J. Perret, « Dexterous grasping tasks generated with an add-on end-effector of a haptic feedback system », *Journal of Computing and Information Science in Engineering*, vol. 16, n° 3, sept. 2016.
4. J.-R. Chardonnet et J.-C. Léon, « Interaction peripheral device capable of controlling an element for touching and grasping multidimensional virtual objects », US20150009145A1, 08-janv-2015.