

Research Topic for the ParisTech/CSC PhD Program

Field: *Design, Information and Communication Sciences and Technologies*

Subfield: Additive Manufacturing, Augmented Reality, Design Methodology, Creativity, Computer Graphics.

Title: Contribution to the integration of Additive Manufacturing and Augmented Reality in early design phases to foster Creativity

ParisTech School: Arts et Métiers ParisTech

Advisor(s) Name: Dr. Frédéric Segonds (HDR)

Dr. Ruding Lou

Advisor(s) Email: frederic.segonds@ensam.eu,

ruding.lou@ensam.eu

(Lab, website): LCPI: <http://lcpi.ensam.eu/>

LISPEN: <http://lispens.ensam.eu/>

Short description of possible research topics for a PhD:

In the product design process, early stages are crucial as 80% of the design costs are engaged during these phases. Creativity is among one of the most important early activity as it allows to create breakthrough innovative products. Ideas are usually produced from inspirational sources such as images, 3D representations etc. These ideas are then retranscribed in ideas sheets to allow to select one (or more) concept to develop and industrialize.

As part of Industry 4.0, the idea generation phase can be enriched by the manipulation of physical objects made in Additive Manufacturing (AM). These objects can be produced on the fly to faithfully represent a concept to develop. In order to make this manipulation even more realistic, Augmented Reality (AR) technologies make it possible to apply a color and texture to a low-fidelity model. It allows users to see different appearances of a physical prototypes through the AR device and, at the same time, users can touch physically the object. Furthermore, with AR users can even change the shape and do some intuitive shape design activities. AR usually allows people to interact with virtual 3D mock-up integrated in the real world. The coupling of the two technologies (AM&AR) will thus favor the innovation of the design teams.

The aim of this PhD is to device and experiment AM&AR applications in the product design creativity activities in order answer the following research question : can experiencing AM&AR technologies foster creativity and innovation?

Required background of the student:

Product design, programming. Interest for AM&AR technologies

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

- Laverne, F., **Segonds, F.**, Anwer, N., & Le Coq, M. (2015). Assembly based methods to support product innovation in Design for Additive Manufacturing: An exploratory case study. *Journal of Mechanical Design*, 137(12)
- Rias, A. L., **Segonds, F.**, Bouchard, C., & Abed, S. (2017). Towards additive manufacturing of intermediate objects (AMIO) for concepts generation. *International Journal on Interactive Design and Manufacturing (IJIDeM)*, 11(2), 301-315.
- B. Li, **R. Lou, F. Segonds**, F. Merienne, “Multi-user interface for co-located real-time work with digital mock-up: a way to foster collaboration?”. *International Journal on Interactive Design and Manufacturing*, 11(3): 609–621. August 2017.
- B. Li, **F. Segonds**, C. Mateev, **R. Lou**, F. Merienne, “Design in context of use: An experiment with a multi-view and multi-representation system for collaborative design”, *Journal of Computers in Industry*, Volume 103, Pages 28-37, 2018.
- B. Faliu, A. Sjarheyeva, **R. Lou**, F. Merienne, “Design and prototyping of an interactive virtual environment to foster citizen participation and creativity in urban design”, 27th International Conference on Information Systems Development (ISD), Lund, Sweden, August 2018.