PHD RESEARCH TOPIC FOR APPLYING THE CSC SCHOLARSHIP

Field: ***Design, Industrialization***

Subfield: Co-design, User-Centered Design, Artificial Intelligence, Digital Twin, Immersive Technologies, Innovation.

Title: **Co-Designing with Emerging Digital Technologies**

Doctoral college: Arts et Métiers Sciences et Technologies
Advisor(s) Name: Frédéric Segonds, Tristan Briard and Ruding Lou
Advisor(s) Email: frederic.segonds@ensam.eu, tristan.briard@ensam.eu, ruding.lou@ensam.eu
Research group/Lab: LCPI (Product Design and Innovation Laboratory)
Lab location: Paris
(Lab website): https://lcpi.ensam.eu/

Short description of possible research topics for a PhD:

Contemporary product design processes increasingly incorporate advanced digital technologies to enhance their outcomes. Specifically, Artificial Intelligence (AI), Digital Twin (DT) and eXtended Reality (XR) technologies offer exclusive capabilities that designers can leverage to support user-centric design approaches (*Cui et al., 2025*). Indeed, altogether, they facilitate the creation of actionable and dynamic artifacts to support co-design with end-users.

AI plays a pivotal role in such design activities. It can quickly generate design alternatives while dynamically integrating user cognitive feedback thereby improving the propositions (*Guillaume et al., 2023).* DT provides a virtual representation of the product, serving as the foundational artifact for co-design. The digital model can incorporate real-world data collected from physical prototypes while also executing functional and usage simulations for iterative refinement (*Tao et al., 2019*). XR offers the immersive interaction tools to integrate virtual product and usage simulations into various environments. This capability allows designers to comprehensively design and test the products with their end-users (*Li et al., 2018*).

Despite the synergies among these technologies, their systematic integration into user-centered design methodologies remains underexplored. Few studies have proposed structured frameworks or tools to fully leverage their combined potential in collaborative design contexts with end-users (*Bertoni, 2023*). This thesis aims to address this gap by developing a methodological approach that bridges the capabilities of AI, DT and XR to support effective co-design practices. Beyond theoretical contributions, the study will deliver practical tools validated in real-world co-design scenarios.

The research will thus be divided into three main phases:

The first year will be dedicated to conducting a comprehensive state of the art on existing methodologies for augmented user-centered design. Particular attention will be given to frameworks integrating AI, DT and/or XR in collaborative processes. This review will inform the formulation of possible research contributions. By the end of this phase, a roadmap will be established to guide their development and validations.

The second and third years will focus on developing and iteratively refining the method and its tools. Experimental campaigns will be conducted to test the propositions in real-world co-design contexts.

The fourth and final year will aim to synthesize all research contributions into a coherent and optimised methodological framework. This phase will thus consolidate and formalise a comprehensive set of practices and tools to bridge AI, DT and XR in effective co-design processes.

Required background of the student:

Master degree in Product Design, User Interaction Design, User Experience Design, Industrial Design or related fields.

References:

- Bertoni, M. (2023). Towards Digital Immersive Experiences for Collaborative Value Co-creation in Design. In L. M. Camarinha-Matos, X. Boucher, & A. Ortiz (Éds.), Collaborative Networks in Digitalization and Society 5.0 (Vol. 688, p. 193 206). Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-42622-3_14
- Cui, J., Mantelet, F., Jean, C., Lou, R., & Segonds, F. (2025). Exploring the usability and creativity enhancement of augmented reality in additive manufacturing-based product design. Computers in Human Behavior Reports, 20, 100816. https://doi.org/10.1016/j.chbr.2025.100816
- Guillaume, R., Pailhès, J., Gruhier, E., Laville, X., Baudin, Y., & Lou, R. (2023). Intent Detection for Virtual Reality Architectural Design. In F. Noël, F. Nyffenegger, L. Rivest, & A. Bouras (Éds.), Product Lifecycle Management. PLM in Transition Times : The Place of Humans and Transformative Technologies (Vol. 667, p. 420 430). Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-25182-5_41
- Li, B., Segonds, F., Mateev, C., Lou, R., & Merienne, F. (2018). Design in context of use : An experiment with a multi-view and multi-representation system for collaborative design. Computers in Industry, 103, 28-37. https://doi.org/10.1016/j.compind.2018.09.006
- Tao, F., Sui, F., Liu, A., Qi, Q., Zhang, M., Song, B., Guo, Z., Lu, S. C.-Y., & Nee, A. Y. C. (2019). Digital twin-driven product design framework. International Journal of Production Research, 57(12), 3935 3953. https://doi.org/10.1080/00207543.2018.1443229