PhD opportunity: Design of multistable architectured materials for automotive interfaces

Abstract: Architectured materials are a new class of engineering materials obtained via a design process aiming at fulfilling a given set of requirements through functionality, behavior, or performance induced by a specific morphological arrangement between multiple phases. Compliant mechanics with multistable configurations [1] can be derived from such materials, enabling specific behaviors with a disruptive potential for human interfaces within the automotive industry.

In the context of a more sustainable and frugal design of automotive-human interfaces, we aim at exploring the possibilities offered by compliant mechanisms in terms of user experience within the car interior, and efficiency for the mechanical system, with a limited number of parts, without external energy sources, etc.

Human morphology, limitation in terms of forces, and proprioceptive analysis will be studied, analyzed and will guide the design of compliant systems. The force amplitude needed for adaptive multistable mechanisms will be determined so as to be compatible with human behavior. Such design principles will be integrated within a mechanical part design methodology using a finite element analysis framework as a basis for optimization [2]. Manufacturability of the designed part will be integrated at this stage.

The main objective of the current project is to propose a methodology to design compliant mechanisms for car interior applications based on a study of architectured materials, such as origami, kirigami, or lattices structures. Prototypes will be manufactured and characterized for validating the proposed modeling, design and human centric approach.

Keywords: architectured materials, compliant mechanisms, design, mechanical engineering.

Background of the candidate: mechanical engineering, physics, design, materials science or any other relevant field.

Location: PIMM, Arts et Métiers, Cnam, CNRS, 151 bd de l'Hôpital, 75013 Paris, France and ISM, Aix-Marseille Université, CNRS, 163 avenue de Luminy, 13288 Marseille, France

Funding: 3-year CIFRE contract with Stellantis, with a salary of ~2300 € net per month.

Starting date: October 2022

Contacts:
Dr. Justin Dirrenberger (PIMM)
justin.dirrenberger@ensam.eu
Dr. Stéphane Viollet (ISM)
stephane.viollet@cnrs.fr

References:
[1] Howell, L. L. (2001). *Compliant Mechanisms*. John Wiley & Sons.
[2] Viard, A. E., Dirrenberger, J., & Forest, S. (2020). Propagating material instabilities in planar architectured materials. *International Journal of Solids and Structures*, 202, 532-551.