The **French-German Research Institute of Saint-Louis (ISL)** situated in the border triangle of Germany, France and Switzerland is an internationally renowned research institute belonging to a global industrial and economic network.
The spectrum of our core activities comprises a variety of topics: aerodynamics, energetic and advanced materials, lasers and electromagnetic technologies, protection, security and situational awareness. Our activities are related to both basic and applied research.

ISL is offering a **PhD Position**

Research field: Protection technologies, security, situational awareness

Study of the mechanical behavior of fiber reinforced composites under impact loading

Current needs in the design and optimization of complex ballistic protection structures lead to the development of more and more accurate numerical modeling of high-velocity impacts. The aim of developing such a tool is to be able to predict the protection performance of structures with few experiments. Putting purely numerical considerations aside, the most important issue to obtain a reliable simulation is to focus on the material behavior modeling (deformation and failure) under very high strain rates and complex stress states. An accurate description of both the projectile and target material behaviors is essential to get an appropriate description of the protection mechanisms. Many efforts have been made regarding the knowledge of the ballistic performance of metallic protective structures used in armored vehicles. Considering body armor, there is a lack of characterization and modeling of the behavior of laminated unidirectional fiber reinforced composites under impact loading.

The main challenge related to high-velocity projectiles impacting composite structures is the complexity of the target architecture involving different materials: the fiber material and the surrounding matrix which are polymers. Moreover, the sensitivity of the mechanical and failure behavior of these two materials towards the strain rate, temperature and stress state plays a significant role in the ballistic performance of the whole system. Thus the objective of this study is to gain a comprehensive understanding of strain, damage and failure mechanisms occurring during the impact of a small caliber ammunition and develop a numerical tool predicting the dynamic response of the protective system.

To reach the mentioned objectives, the PhD thesis will deal with the following points:

- Literature review focusing on the modelling of the dynamic mechanical behavior of the materials composing fiber based composite body armors,
- Mechanical characterization of the materials with the development of dedicated experimental techniques,
- Modeling of the behavior and failure of the materials, and selection of suited numerical methods,
- Numerical simulation of the impact of a projectile on a body armor, study of the influence of the parameters (geometry, velocity, etc.) on the mechanisms involved during the penetration,
- Validation of the material models with ballistic tests carried out at ISL.

Qualifications

- Strong knowledge in mechanics, metallurgy, finite element method, numerical simulation,
- Master 2 or Engineer degree validated in Mechanics or Material sciences,
- Organizational skills, ability to work effectively as a part of a team, communication skills,
- Perfect knowledge of English,
- Strong writing skills and an ability to speak in public.

French-German Research Institute of Saint-Louis (ISL)

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