Sujet thèse / PhD subject 2025

Titre Thèse	Multiphysics Inference System for Multiparameter High-Temperature Gradient Sensors in Turbulence Measurement and Real-Time Gas Analysis.	
PhD Title		
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Laboratoire	IEMN	Web : www.iemn.fr
Groupe(s)	AIMAN-FILMS	Web : https://www.iemn.fr/la-recherche/les-groupes/aiman-films
Projet phare principal		
Demande de fléchage IEMN ? (Energie / Nanocaractérisation / Technologies Neuromorphiques)	Oui ./ Non : non Flagship choisi :	
Demande de labellisation Université de Lille (GREAL, labellisée)	Oui / Non : Label :	
Financement acquis Oui ☐ Non ☑ Partiel ☐	Si acquis (total ou partiel), préciser : (contrat, organisme, Université étrangère, , ….) :	
Financement demandé	Contrat Doctoral Etablissement	ULille ☐ Centrale Lille ☑ JUNIA ☐
	Région ou Autre Préciser :	Co financement (Préciser l'origine, demande en cours, et si acquis ou pas) :
		CLI et Région HdF ; demande en cours

Phd project:

Turbulence remains one of the most complex unresolved phenomena in classical physics, especially in **high Reynolds number flows** and **intricate geometries** found in industrial applications. The limitations of purely numerical methods underscore the critical need for **advanced instrumentation systems** that can provide accurate, empirical data. In this context, the development of **Wall Shear Stress (WSS) sensors** is essential for studying turbulent flows in **aeronautics** and related industries. The AIMAN group at IEMN has led groundbreaking efforts in **thermal MEMS technologies**, resulting in the innovative **High-Temperature Gradient Sensor (HTGS)**, which measures **thermal conductivity, diffusivity, temperature,** and **pressure**.

This thesis aims to advance **HTGS technology** by incorporating **silicon carbide (SiC)**, enabling operation in **harsh, high-temperature, and chemically reactive environments**. Additionally, the project will develop a modular, embedded **Acquisition and Multiphysics Inference (AIMu)** system that fully exploits the capabilities of HTGS sensors for **wind tunnel testing** and **gas analysis**. The AIMu system will incorporate **high-speed, high-resolution acquisition channels**, providing **real-time data analysis** and **AI-based inference** to autonomously monitor and control **multiphysics phenomena**.

The project will also include extensive **wind tunnel testing** in collaboration with **ONERA**, using both **low-speed** and **high-speed wind tunnels** to calibrate and validate the sensors across various flow regimes, from **subsonic** to **supersonic**. These tests will ensure the HTGS sensors are capable of accurate and reliable measurements of **wall shear stress** and **pressure**, ultimately advancing the state of the art in both **aerodynamic** and **industrial applications**.

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