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ONERA
THE FRENCH AEROSPACE LAB

PROPOSITION DE STAGE EN COURS D'ETUDES

Référence : **DMPE-2024-25**
(à rappeler dans toute correspondance)

Lieu : Toulouse

Département/Dir./Serv. : DMPE

Tél. :

Responsable(s) du stage : Rémi RONCEN & José CARDESA

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DESCRIPTION DU STAGE

Thématique(s) : Dynamique des écoulements pariétaux

Type de stage : ☒ Fin d'études bac+5 ☒ Master 2 ☐ Bac+2 à bac+4 ☐ Autres

Intitulé : Exploring Forced and Decaying Turbulence in Porous Media

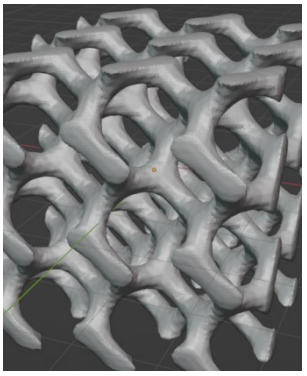
Background

Turbulence in porous media is a complex and critical phenomenon with implications in various fields, including geophysics, environmental engineering, and aeronautics. Understanding the behavior of turbulence within porous structures is crucial for optimizing fluid transport and dispersion processes, as it features unique characteristics and fundamental challenges. In this internship, we aim to investigate turbulence characteristics within porous media using advanced computational techniques and experimental methods.

The three identified Research Objectives are:

I./ Characterizing Turbulence in Porous Media

You will explore turbulence within porous media represented by triply periodic minimal surface (TPMS) matrices. You will use Direct Numerical Simulations (DNS) to investigate some key turbulence properties, such as turbulent kinetic energy (TKE) transport, anisotropy distribution, and the scales of turbulent motion.



Porous sample

II./ Experimental Validation with PIV

For selected test cases, you will 3D-print a TPMS sample and help conduct Particle Image Velocimetry (PIV) experiments to compare with the computational findings.

III./ Linking Pore Topology to Features of the Turbulence

Using the numerical and experimental databases obtained in I and II, you will then explore how different TPMS structures influence turbulence behavior and acoustic phenomena within porous media. To this end, data analysis tools including sparse regression and Bayesian inference will be used.

Expected Outcomes

This internship aims to extend our understanding of turbulence within porous media, particularly with respect to TPMS matrices. The results will have implications for improving our ability to model and predict fluid flow and dispersion in porous structures, with potential applications in aerospace/aeronautics, which are at the core of ONERA research.

The expected outcomes of this internship will take the shape of a general report, summarizing your findings, and potentially of an article to be written for publication in an appropriate journal. The findings will allow us to:

1. Identify mechanisms governing turbulent energy in porous media.
2. Explore the link between pore topology and turbulence characteristics.

Prerequisites

While motivation and autonomy are two key factors for a successful internship, the following prerequisite are also excepted from the candidates:

1. Strong background in fluid mechanics and computational fluid dynamics (CFD).
2. Interest in experimental fluid dynamics and data analysis.
3. Motivation to explore complex and interdisciplinary research questions.

It is initially expected that this internship will be 60% CFD, 10% experiments, and 30% data analysis/modeling.

Additionally, note that a PhD position will be opened on a similar topic in October 2024, with a stronger focus on experiments.

Est-il possible d'envisager un travail en binôme ? **Non**

Méthodes à mettre en oeuvre :

☒ Recherche théorique	☒ Travail de synthèse
☒ Recherche appliquée	☒ Travail de documentation
☐ Recherche expérimentale	☒ Participation à une réalisation

Possibilité de prolongation en thèse : **Oui**

Durée du stage : Minimum : 4 Maximum : 5

Période souhaitée : February-July

PROFIL DU STAGIAIRE

Connaissances et niveau requis :	Ecoles ou établissements souhaités :
python, free-flow turbulence, numerical simulations (CFD)	Engineering schools