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RÉPUBLIQUE FRANÇAISE
Liberté Égalité Fraternité

ONERA
THE FRENCH AEROSPACE LAB

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PROPOSITION DE STAGE EN COURS D'ETUDES

Référence : **DTIS-2025-62**
(à rappeler dans toute correspondance)

Lieu : Palaiseau

Département/Dir./Serv. : DTIS/MIC

Tél. : 01 80 38 65 61

Responsable(s) du stage : F. Champagnat, A. Plyer

Email. : Frederic.champagnat@onera.fr
Aurelien.plyer@onera.fr

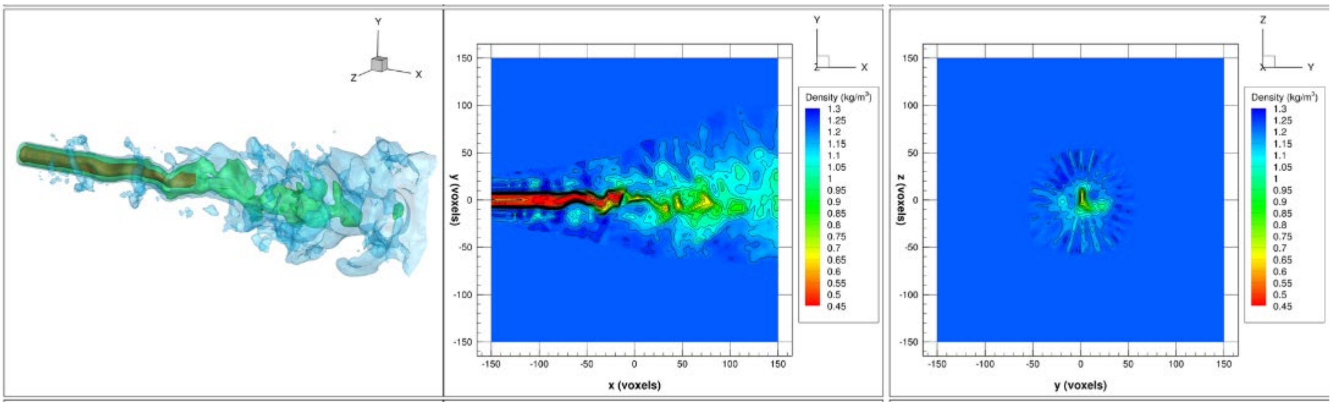
DESCRIPTION DU STAGE

Thématique(s) : Perception et traitement de l'information

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

Intitulé :

Sujet : Neural Volumetric Representation for 3D Background Oriented Schlieren (BOS)



Background Oriented Schlieren (BOS) is a non-intrusive method widely used to visualize fluid density fields, particularly in wind tunnels applications. The primary goal of this internship is to explore and develop new volumetric representation methods based on approaches such as Neural Representation like presented in Neural Radiance Fields (NeRF) to enhance 3D reconstruction in the context of BOS.

- Review the state-of-the-art in 3D reconstruction techniques, with a particular focus on volumetric methods and neural representations like NeRF and in Physically Informed Neural Network (PINN's).
- Adapt and implement volumetric representation models for 3D BOS visualization, considering the specifics of the technique (experimental multi-view snapshots or high temporal resolution axisymmetric reconstructions).
- Develop a software prototype capable of processing BOS data to generate 3D volumetric representations.
- Assess the performance of the developed model in terms of accuracy, spatial and temporal resolution, as well as computational efficiency.

Required Skills:

Knowledge in image processing, computer vision, and 3D reconstruction techniques. Experience in programming (Python, C++, ...) and deep learning frameworks (TensorFlow, PyTorch, JAX...).

Understanding of BOS principles and aerothermal phenomena.

Ability to work independently on an research topic.

Bibliography

[1] Cai, S., Wang, Z., Fuest, F., Jeon, Y. J., Gray, C., & Karniadakis, G. E. (2021). Flow over an espresso cup: inferring 3-D velocity and pressure fields from tomographic background oriented Schlieren via physics-informed neural networks. Journal of Fluid Mechanics, 915, A102.

[2] Nicolas, F., Todoroff, V., Plyer, A., Le Besnerais, G., Donjat, D., Micheli, F., Champagnat & Le Sant, Y. (2016). A direct approach for instantaneous 3D density field reconstruction from background-oriented schlieren (BOS) measurements. Experiments in fluids, 57, 1-21.

[3] Molnar, J. P., Grauer, S. J., Léon, O., Donjat, D., & Nicolas, F. (2023). Physics-informed background-oriented schlieren of turbulent underexpanded jets. In AIAA SciTech 2023 Forum (p. 2441).

[4] Kim, D., Lee, M., & Museth, K. (2024). Neuralvdb: High-resolution sparse volume representation using hierarchical neural networks. ACM Transactions on Graphics, 43(2), 1-21.

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 mois Maximum : 5 mois

Période souhaitée : Mars – Juillet 2025

PROFIL DU STAGIAIRE

Connaissances et niveau requis :	Ecoles ou établissements souhaités :
Master in machine learning and/or computer vision, knowledge in optics will be appreciated	