Thibault Moli MAUREL OUJIA

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EXPERIENCE

Temporary Teaching and Research Associate (ATER)
Aix–Marseille University, France

📅 Sept 2023—Sept 2024   📍 Marseille, France

JSPS Short-term Fellowship 2023
JAMSTEC & Nagoya University, Japan

📅 May 2023—Aug 2023   📍 Yokohama & Nagoya, Japan

- **Host** : Dr. Keigo Matsuda and Prof. Katsunori Yoshimatsu
- **Title** : Development of parallelized tessellation-based divergence & rotation of particle laden turbulence
- **Description** : Engaged in an intensive research program with JAMSTEC and Nagoya University. Developed parallel computing codes in C++ leveraging MPI to calculate particle divergence and curl. Successfully ported existing multiscale tessellation methods to C++, streamlining computational workflows. Conducted and analyzed realistic simulations of cloud turbulence, both with and without gravity, to explore particle behavior in complex fluid systems. Utilized cutting-edge neural network models like Autoencoders, U–Nets, GANs, and diffusion models to predict particle density, advancing the state of the art in turbulent flow simulations.

CTR Summer Program 2022
Stanford University, CA, USA

📅 July 2022—Aug 2022   📍 Palo Alto, CA, USA

- **Team** : K. Schneider, K. Matsuda, T. Oujia, J. West, S. S. Jain and K. Maeda
- **Title** : Development of multiscale techniques for analyzing clustering in particle laden turbulence, including tools from machine learning.
- **Description** : Collaborated with a multidisciplinary team at the forefront of turbulence research to extend the study of divergence, curl, and helicity in channel flow dynamics. Developed multiscale techniques based on Delaunay tessellation to investigate divergence contributions at varying scales. Employed neural networks, including Autoencoders, U–Nets, and GANs, to evaluate their efficacy in synthesizing particle density based on vorticity for different particle masses.
- **Sponsor** : Stanford University, NASA, ONR, AFOSR, and DOE

Co–supervision of master thesis
Aix–Marseille University, France

- **Supervisor** : Prof. Kai Schneider (I2M–France) and Thibault Oujia (I2M–France)
- **Subject** : Two–dimensional Characteristic Mapping Method using CUDA

📅 Sept 2021—Mar 2022   **Student** : Julius Bergmann (TU Berlin–Germany)

📅 April 2021—Sept 2021   **Student** : Nicolas Saber (I2M–France)

Internship at I2M
Aix–Marseille University, France

📅 April 2020—Sept 2020   📍 Marseille, France

- **Supervisor** : Prof. Kai Schneider (I2M–France) and Dr. Keigo Matsuda (JAMSTEC–Japan)

IT SKILLS

- C/C++ (CUDA/MPI)
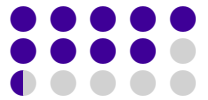- Python (PyTorch/TensorFlow)
- HTML/CSS
- Office Pack, LaTeX
- Linux, Windows, MacOS

LANGUAGES

French	●●●●●
English	●●●●○
German	◐○○○○

EDUCATION

Ph.D. student in Mathematics
Funded by ANR, project CM2E
In collaboration with McGill University (Montréal, Canada) and LMFA (Lyon, France)

Aix–Marseille University, France

📅 Jan 2021—Present

Master in applied mathematics
(Mathematics and applications: Computational Science, Partial Differential Equations, Probability, Statistics)
Including courses co-taught with École Centrale

Aix–Marseille University, France

📅 Sept 2018—June 2020

Bachelor in Mathematics
Aix–Marseille University, France

📅 Sept 2015—June 2018

Baccalauréat Scientifique
(High School Diploma)

Lycée Thiers, Marseille, France

📅 Sept 2014—June 2015

- **Title** : Divergence and curl operators based on Voronoi tessellation: Application to particle laden turbulence
- **Description** : Conducted groundbreaking research on computational fluid dynamics, specifically focusing on divergence and curl operators derived from Voronoi tessellation. Devised novel methods to calculate divergence based on volumetric changes in Voronoi cells and derived the curl operator through cell rotation. Additionally, spearheaded preliminary studies on the potential of using neural networks to synthesize particle distributions in turbulent flows. The research has implications for enhanced numerical simulations and real-world applications in particle-laden turbulence.

MAIN PUBLICATIONS

📄 Journal Articles

- T. Maurel–Oujia, K. Matsuda, and K. Schneider, "Computing differential operators of the particle velocity in moving particle clouds using tessellations," arXiv:2212.03580, *under revision, Journal of Computational Physics*, 2023.
- J. West, T. Maurel–Oujia, K. Matsuda, K. Schneider, S. S. Jain, and K. Maeda, "Clustering, rotation, and swirl of inertial particles in turbulent channel flow," *submitted, International Journal of Multiphase Flow*, 2023.
- T. Maurel–Oujia, S. S. Jain, K. Matsuda, K. Schneider, J. West, and K. Maeda, "Neural networks to predict preferential concentration of particles in isotropic turbulence," *preprint*, 2023.
- Z. Lin, T. Maurel–Oujia, B. Kadoch, P. Krah, N. Saura, S. Benkadda, and K. Schneider, "Synthesizing impurity clustering in the edge plasma of tokamaks using neural networks," *submitted, Physics of Plasmas*, 2023.
- Z. Lin, T. Maurel–Oujia, S. Benkadda, and K. Schneider, "Tessellation-based analysis of impurity clustering in the edge plasma of tokamaks," *to be submitted to Journal of Plasma Physics*, 2023.
- S. V. Apte, T. Oujia, K. Matsuda, B. Kadoch, X. He, and K. Schneider, "Clustering of inertial particles in turbulent flow through a porous unit cell," *Journal of Fluid Mechanics*, vol. 937, 2022.
- T. Oujia, K. Matsuda, and K. Schneider, "Divergence and convergence of inertial particles in high-reynolds-number turbulence," *Journal of Fluid Mechanics*, vol. 905, 2020.

📊 Refereed Proceedings

- T. Maurel–Oujia, K. Matsuda, and K. Schneider, "Multiresolution analysis of convergence and divergence of inertial particle velocity in turbulence," submitted to 13th Turbulence and Shear Flow Phenomena (TSFP13).
- T. Maurel–Oujia, S. S. Jain, K. Matsuda, K. Schneider, J. West, and K. Maeda, "Synthesis of preferential concentration of particles in isotropic turbulence using neural networks," in *18th European Turbulence Conference (ETC18)*.
- K. Matsuda, T. Maurel–Oujia, and K. Schneider, "Clustering formation of inertial particles in high reynolds number isotropic turbulence," in *18th European Turbulence Conference (ETC18)*.
- J. Bergmann, T. Maurel–Oujia, X. Y. Yin, J.-C. Nave, and K. Schneider, "On singularities in vortex sheets in 2d euler flows using a high resolution characteristic mapping method," in *18th European Turbulence Conference (ETC18)*.
- T. Oujia, J. West, K. Matsuda, K. Schneider, S. S. Jain, and K. Maeda, "Divergence and rotation of inertial particles in a four-way coupled channel flow," in *11th International Conference on Multiphase Flow (ICMF)*.
- T. Oujia, S. S. Jain, K. Matsuda, K. Schneider, J. West, and K. Maeda, "Neural networks for synthesizing preferential concentration of particles," in *Center for Turbulence Research (CTR), Proceedings of the Summer Program 2022*, 2022, Stanford University.
- J. West, T. Oujia, K. Matsuda, K. Schneider, S. S. Jain, and K. Maeda, "Divergence and curl of the inertial particle velocity in a four way coupled turbulent channel flow," in *Center for Turbulence Research (CTR), Proceedings of the Summer Program 2022*, 2022, Stanford University.
- K. Matsuda, K. Schneider, T. Oujia, J. West, S. S. Jain, and K. Maeda, "Multiresolution analysis of inertial particle tessellations for clustering dynamics," in *Center for Turbulence Research (CTR), Proceedings of the Summer Program 2022*, 2022, Stanford University.
- T. Oujia, K. Matsuda, and K. Schneider, "Extreme divergence and rotation values of the inertial particle velocity in high reynolds number turbulence using delaunay tesselation," in *12th Turbulence and Shear Flow Phenomena (TSFP12)*.

👥 Oral presentations

- T. Maurel–Oujia, S. S. Jain, K. Matsuda, K. Schneider, J. West, and K. Maeda, "Synthesis of preferential concentration of particles in isotropic turbulence using neural networks," in *ETC-18*, 2023, Valencia, Spain.
- T. Maurel–Oujia, K. Matsuda, and K. Schneider, "A tessellation-based approach to analyze elementary processes of inertial particles in turbulence," in *RIMS workshop*, 2023, Kyoto, Japan.

- T. Oujia, J. West, K. Matsuda, K. Schneider, S. S. Jain, and K. Maeda, "Divergence and rotation of inertial particles in a four-way coupled channel flow," in *11th International Conference on Multiphase Flow (ICMF2023)*, 2023, Kobe, Japan.
- T. Oujia, S. S. Jain, K. Matsuda, K. Schneider, J. West, and K. Maeda, "Neural networks for synthesizing preferential concentration of particles in isotropic turbulence," in *75th APS Division of Fluid Dynamics Meeting*, 2022, Indianapolis, USA.
- T. Oujia, K. Matsuda, and K. Schneider, "Extreme divergence and rotation values of the inertial particle velocity in high reynolds number turbulence using delaunay tesselation," in *12th International Symposium on Turbulence and Shear Flow Phenomena (TSFP12)*, 2022, Osaka, Japan.
- T. Oujia, K. Matsuda, and K. Schneider, "Analysis of divergence and rotation of the intertial particle velocity in high reynolds number turbulence," in *73rd APS Division of Fluid Dynamics Meeting*, 2020, Chicago, USA.
- T. Oujia, K. Matsuda, and K. Schneider, "Divergence and convergence of inertial particles in high reynolds number turbulence," in *72nd APS Division of Fluid Dynamics Meeting*, 2019, Seattle, USA.
- T. Oujia, K. Matsuda, and K. Schneider, "Statistical analyses and voronoi tessellation to study inertial particle clustering in turbulence," in *International Workshop on Multiphase Turbulence and Statistical Modeling*, 2019, Marseille, France.

🖳 Invited seminar talks

- "A Tessellation-based Approach for Multiscale Dynamics in Particle-Laden Turbulence", 2023, *CEIST Guest Seminar*, JAM-STEC, Yokohama, Japan.
- "A Tessellation-based Approach for Multiscale Dynamics in Particle-Laden Turbulence", 2023, *Fluid Mechanics Special Seminar*, Nagoya Institute of Technology, Nagoya, Japan.
- "A tessellation-based approach to study the dynamics of inertial particles in turbulence", 2023, *Onishi Lab. Seminar Series*, Tokyo Institute of Technology, Tokyo, Japan.
- "Physics-informed neural networks for synthesizing preferential concentration of particles in isotropic turbulence", 2022, *PiAI Seminar Series*, Web Seminar.

☰ Proceedings

- T. Maurel–Oujia, K. Matsuda, and K. Schneider, "Multiscale analysis of inertial particle dynamics in turbulent flows using a tessellation-based method," in. Bull. Amer. Phys. Soc., 2023.
- T. Maurel–Oujia, S. Jain, K. Matsuda, K. Schneider, J. West, and K. Maeda, "Synthesizing inertial particle distribution in isotropic turbulence using neural networks," in. Bull. Amer. Phys. Soc., 2023.
- L. Zetao, T. Maurel–Oujia, B. Kadoch, P. Krah, N. Saura, S. Benkadda, and K. Schneider, "Analysis of inertial impurity clustering in the edge plasma of tokamaks," in. EFTC 2023, 20th European Fusion Theory Conference, 2023.
- L. Zetao, T. Maurel–Oujia, B. Kadoch, P. Krah, N. Saura, S. Benkadda, and K. Schneider, "Data-driven modeling of impurity transport in the edge plasma of tokamaks," in. 12th ITER International School, 2023.
- J. Bergmann, T. Oujia, X.-Y. B. Yin, J.-C. Nave, and K. Schneider, "High resolution vortex layer computations in 2d euler flows using a characteristic mapping method," in. Bull. Amer. Phys. Soc., 2022, 67(19).
- T. Oujia, S. Jain, K. Matsuda, K. Schneider, J. West, and K. Maeda, "Physics-informed neural networks for synthesizing preferential concentration of particles in turbulent flows," in. Bull. Amer. Phys. Soc., 2022, 67(19).
- K. Schneider, T. Oujia, J. West, K. Matsuda, S. Jain, and K. Maeda, "On divergence, curl, and helicity of the inertial particle velocity in a 4-way coupled channel flow," in. Bull. Amer. Phys. Soc., 2022, 75th Annual Meeting of the Division of Fluid Dynamics, Volume 67, Number 19, November 20-22, 2022, Indiana Convention Center, Indianapolis, Indiana.
- T. Oujia, K. Matsuda, and K. Schneider, "Quantifying divergence and rotation of the inertial particle velocity in high reynolds number turbulence using voronoi and delaunay tessellation," in. Bull. Amer. Phys. Soc., 2021, 66(17).
- T. Oujia, K. Matsuda, and K. Schneider, "Analysis of divergence and rotation of the intertial particle velocity in high reynolds number turbulence," in. Bull. Amer. Phys. Soc., 2020, 65(13).
- X. He, T. Oujia, B. Kadoch, K. Matsuda, K. Schneider, and S. Apte, "Clustering of inertial particles in turbulent flow through a face-centered cubic cell," in. Bull. Amer. Phys. Soc., 2020, 65(13).
- T. Oujia, K. Matsuda, and K. Schneider, "On the divergence of the inertial particle velocity in high reynolds number turbulence," in. XXV ICTAM, 2020, 23-28 August 2020, Milano, Italy, cancelled due to COVID-19.
- T. Oujia, K. Matsuda, and K. Schneider, "Divergence and convergence of inertial particles in high reynolds number turbulence," in. Bull. Amer. Phys. Soc., 2019, 64(13), 639.
- S. Apte, T. Oujia, X. He, B. Kadoch, K. Matsuda, and K. Schneider, "Pore-scale investigation of clustering of inertial particles in turbulent flow through a porous medium," in. Bull. Amer. Phys. Soc., 2019, 64(13), 638.