International Workshop on Multiphase Flows: Analysis, Modelling and Numerics

Date: 10 – 11 January 2025

Venue: Room 102, Green Computing Systems Research Organization, Bldg 40, Waseda University

Invited Speakers:

Yuki Ueda (Hokkaido University)

Tomohiro Sogabe (Nagoya University)

Katsunori Yoshimatsu (Nagoya University)

Tsuyoshi Yoneda (Hitotsubashi University)

Speakers:

Yusaku Abe (Waseda University)

Yuta Koizumi (Waseda University)

Zhixuan Xu (Nagoya University)

Takahiro Nakamura (Waseda University)

Organizers:

Hideo Kozono (Waseda University)

Kenji Takizawa (Waseda University)

Takahito Kashiwabara (The University of Tokyo)

Keiichi Watanabe (Suwa University of Science)

Takuya Terahara (Waseda University)

Abstracts:

Yuki Ueda (Hokkaido University)

Survey and Application of Bayesian Inference to Inverse Problem

The concept of the inverse problem provides a way of finding appropriate parameters that will give a desired numerical result. The Bayesian approach to the inverse problem has been developed in the field of date science and is now applied in many fields. In this talk, we review the framework of the Bayesian approach and show some applications.

Tomohiro Sogabe (Nagoya University)

Our Research on Numerical Linear Algebra

Numerical Linear Algebra deals with numerical algorithms for solving linear systems, eigenvalue problems, singular value problems, and least squares problems. Since these problems frequently arise in computational science (e.g., computational physics, aerospace, meteorology, medical & pharmaceutical sciences), data science, and informational science, there is a strong need for fast and efficient numerical algorithms to address large-scale problems.

In this talk, I will explain our past and recent work on the solution of linear systems and eigenvalue problems. As for linear systems, I will discuss Krylov subspace methods, which have been recognized as one of the top 10 algorithms of the 20th century (SIAM News, 2000). Despite their more than 60-year history, Krylov subspace methods remain an active research field, particularly as the size of matrices continues to grow. Concerning eigenvalue problems, I will talk about several numerical algorithms for computing specific required eigenvalues and their corresponding eigenvectors. If time permits, I will touch upon other related topics such as matrix functions, tensor computations (numerical multilinear algebra), and quantum computation.

Katsunori Yoshimatsu (Nagoya University)

Large-scale structure and small-scale universality of passive scalar turbulence

We study theoretically and numerically large-scale structure and small-scale universality of passive scalar turbulence, where the scalar field is passively convected by turbulent flow. The fluid is incompressible. The flow is assumed to be statistically homogeneous. The large-scale structure plays a key role in the decay laws of the passive scalar field without any scalar source. Statistical universality is thought to exist at small scales for passive scalar turbulence at sufficiently high P¥'eclet number. This talk discusses a certain type of large-scale structure, followed by a recent work on the influence of a uniform mean scalar gradient on small-scale mixed velocity-scalar statistics.

Tsuyoshi Yoneda (Hitotsubashi University)

Effectiveness of Littlewood-Paley theory in the study of turbulence and machine learning

In this talk, I will explain recent works on turbulence and machine learning in terms of scale decomposition. Goto-Saito-Kawahara (2017) employed the Littlewood-Paley decomposition applying to 3D Navier-Stokes turbulence. By direct numerical simulations, they discovered that each scale vortices transfer energy to the adjacent smaller scale vortices through stretching process. In this talk, I will explain that the vortex stretching spills over into the dissipation range and mathematically show that the vortex stretching truly enhances the dissipation rate. Next, I will explain that such scale decomposition method is alsouseful for machine learning (Reservoir computing). More specifically, I will present a future forecasting study of the ElNino phenomenon.