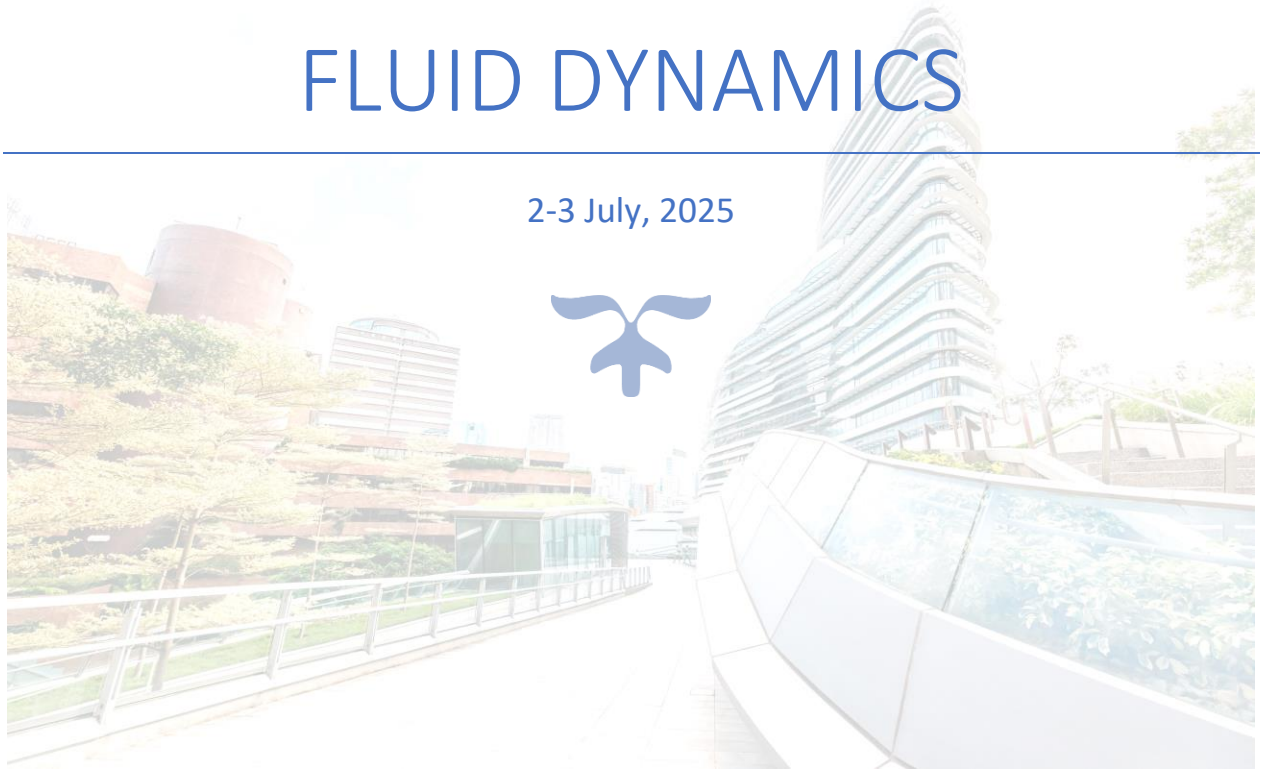
WORKSHOP IN PDES FROM FLUID DYNAMICS

2-3 July, 2025



DEPARTMENT OF APPLIED MATHEMATICS
THE HONG KONG POLYTECHNIC UNIVERSITY
Research Grants Council of Hong Kong

THE HONG KONG POLYTECHNIC UNIVERSITY 香港理工大學

DEPARTMENT OF APPLIED MATHEMATICS 應用數學系

General Information

- Registration: 9:30-10:00am on 2 July at Y305.
  - There are directions for the conference room and the restaurant for lunch when you enter the campus.

- Venue: Room 305, Building Y, PolyU.

- Banquet: 6:00-8:00pm on 2 July. All Speakers and Chairs are invited.
  Restaurant: Choi Fook Royal Banquet (Fortune Metropolis)
  Address: Shop 821-822, 858, 8/F, Fortune Metropolis, 6 Metropolis Drive, Hung Hom.

- Lunch:
  At Ju Yin House Seafood Restaurant at 4/F, Communal Building, PolyU.
  Please refer to the campus map on Page 9.

- Sponsors:
  Research Grants Councils
  Department of Applied Mathematics, The Hong Kong Polytechnic University

- Organizing Committee:

Hu Xianpeng	The Hong Kong Polytechnic University
Wang Dehua	University of Pittsburgh

On-campus Internet Access

Wi-Fi access is provided during the workshop period. Please use the login name and password listed below.

Network: PolyUWLAN
Username: gstama
Password: Polyu4ever

Webpage

https://events.polyu.edu.hk/pdes_in_fd/home

Program

July 2, 2025	Speaker	Chair
10:00-10:10am	Opening Remark	Wang Dehua/Hu Xianpeng
10:10-10:50am	Wang Yaguang	Wang Dehua
10:55-11:35am	Chen Ming	Wang Dehua
11:40-12nn	Free Discussion	
12nn-2pm	Lunch	Ju Yin House
2-2:40pm	Yang Xiaozhou	Luo Tao
2:45-3:25pm	Wang Yong	Luo Tao
3:30-4:00pm	Tea Break	
4:00-4:40pm	Xie Feng	Zhang Zhu
4:45-5:25pm	Xu Runzhang	Zhang Zhu
5:30-6pm	Free Discussion	
6pm-8pm	Banquet	

July 3, 2025	Speaker	Chair
9:30-10:30am	Free Discussion	
10:30-11:10am	Wang Yi	Liu Shuangqian
11:15-11:55am	Xiang Wei	Liu Shuangqian
12nn-2pm	Lunch	Ju Yin House
2-2:40pm	Zhao Wenbin	Cao Xinlin
2:45-3:25	Liu Song	Cao Xinlin
3:30-4:00pm	Tea Break	
4:00-4:40pm	Lian Wei	Hu Xianpeng
4:45-5:25pm	Gao Xin	Hu Xianpeng
5:30-5:40pm	Closing	Wang Dehua/Hu Xianpeng

Title and Abstracts

Nonuniqueness of Continuous Solutions for 1D Conservation Laws

Chen Ming

University of Pittsburgh

We present a class of 2x2 systems of conservation laws for which non-uniqueness arises in the space of Continuous one-dimensional solutions. This shows that the Liu entropy condition-while sufficient to Ensure uniqueness for small BV solutions-is not enough to guarantee uniqueness in the continuous category, even in the one-dimensional setting. We construct explicit examples of such systems that still enjoy stability and uniqueness within the BV framework. Our approach is based on the method of convex integration and constitutes the first application of this technique to produce non-unique continuous solutions in one spatial dimension. This is joint work with Alexis Vasseur and Cheng Yu.

Transonic Shock Solutions with Large Swirl Velocity in a Finite Cylinder

Gao Xin

The Hong Kong Polytechnic University

In this talk, we introduce our recent work on the existence and location of three-dimensional transonic shock solutions with large swirl velocity for axisymmetric full Euler equations in a cylinder, with appropriate boundary conditions at the entrance of the nozzle and a prescribed pressure condition at the exit of the nozzle. This is the first mathematical result on three-dimensional transonic shocks with large swirl velocity.

Transverse instability of periodic waves to Hamiltonian PDEs

Lian Wei

Norwegian University of Science and Technology

The passage from linear instability to nonlinear instability has been shown for 1D solitary waves under 2D perturbations. Although transverse instability of periodic waves to the KdV equation under the KP-I flow has been expected to be true from spectral instability for a long time, it has not been clear how to adapt the general instability theory for solitary waves to periodic waves until now. In this talk, we present how such an adaptation works with the aid of exponential trichotomies and an approximate scheme. Joint work with Erik Wahlén.

Two-Dimensional Steady Euler Flow in Infinitely Long Nozzle for General Pressure

Liu Song

Hong Kong Polytechnic University

In this talk, I will present the global existence result for uniformly subsonic flow governed by the two-dimensional steady Euler equations in an infinitely long nozzle. We first derive an equivalent system from the conservation laws along the streamlines and formulate the boundary value problem for a quasi-linear elliptic equation of the stream function. Our analysis focuses on general pressure laws where enthalpy admits a separable form in pressure and entropy. This necessitates careful extensions and deliberate modifications to the entropy and Bernoulli functions. For the local problem, a scaling technique combined with uniform estimates enables control of the Mach number when the inlet mass flux is sufficiently small. Global existence is then established via the Arzela-Ascoli theorem. This is a joint work with Prof. Feimin Huang and Prof. Tian-Yi Wang.

Wellposedness and regularization-by-noise for the stochastic Prandtl equation

Wang Yaguang

Shanghai Jiao Tong University

In this talk, we study the local and global existence of analytic/Gevrey solutions to the stochastic Prandtl equation in two and three dimensions, from which we observe the regularization effect of the noise. This is a joint work with Meng Zhao.

Vanishing viscosity limit of two interacting shocks from same family for 1D compressible isentropic Navier-Stokes equations

Wang Yi

Academy of Mathematics and Systems, CAS

We study the vanishing viscosity limit of two interacting shocks from the same characteristic family for one-dimensional (1D) isentropic compressible Navier-Stokes equations. Unlike the case two interacting shocks from the different characteristic families form two outgoing shocks for 1D compressible isentropic Euler equations, two interacting shocks with the overtaking of a shock by another from the same characteristic family will produce a stronger shock and a weak rarefaction wave from the transverse field. Two main difficulties are encountered. One is that two interacting weak shocks from the same characteristic family is more singular than the head-on shock collisions from different families. Another one is the incompatibilities of the stability proof frameworks of the shock and rarefaction waves. Both difficulties are overcome by ultimately using the a-contraction method with time-dependent shifts for the shocks to justify the vanishing physical viscosity limit process. Moreover, the decay rate with respect to the viscosity is obtained. The talk is based on the joint work with Dr. Lin-an Li from Beijing Normal University and Prof. Dehua Wang from University of Pittsburgh.

Steady Prandtl Expansion for Subsonic Flows

Wang Yong

Academy of Mathematics and Systems, CAS

Assuming construction of Prandtl and its high order corrections for compressible fluids with small Mach number, we establish nonlinear remainder bound and justify the validity of the Prandtl layer expansion

in the inviscid limit for an insulated boundary. To solve the full steady compressible Navier-Stokes system, which consists a div-curl reduction of the momentum equations to an elliptic system for the stream function ϕ as well as a transport equation for the pressure p. The construction of ϕ is based on an improved Guo-Iyer's H^{4} theory for incompressible flows via development of a H_{00}^{1/2} technique with a type viscous-inflow BC, and the pressure p is solved by imposing a key additional viscous-inflow boundary condition as

\begin{equation}

\big\{(\mu +\lambda)u_{s}\Delta_{\varepsilon} p + 2(\frac{\mu}{\lambda}+1)p_s (1-\frac{1}{2}u_s^2)p_{x}\big\}\big|_{x=0}\backsim \text{given.}

\end{equation}

We reformulate the energy equation in terms of the pseudo entropy S (not the temperature), which exhibits a crucial uniform bound for the final closure. The talk is based on a joint work with Yan Guo.

Stability of contact discontinuity in nozzles

Xiang Wei

City University of Hong Kong

There can be contact discontinuities in the nozzle for the compressible Euler flow. In this talk, we will talk about the cases of the subsonic-supersonic, and supersonic-supersonic contact discontinuity in nozzles and establish the well-posedness results.

Vanishing dissipation limit and related boundary layer analysis of MHD equation

Xie Feng

Shanghai Jiao Tong University

In this talk I will discuss the vanishing dissipation limit of solutions to initial boundary value problem of MHD equation, where the velocity is always imposed the no-slip boundary condition. We focus on the effect of different type of magnetic field on vanishing dissipation limit process. Both incompressible and compressible MHD equations are involved.

Global quantitative stability of wave equations with strong and weak dampings

Xu Runzhang

Harbin Engineering University

In this talk, we are concerned with the description of global quantitative stability of wave equations with linear strong damping and linear or nonlinear weak damping. By giving some energy decay estimates, we obtain several conclusions about the continuous dependence of the global solution on the initial data and the coefficients of the strong damping term and linear or nonlinear weak damping term. This work also establishes a new idea to use the dissipative effect to obtain the better continuous dependence conclusions, which also reflect the dissipative properties of the solution.

High concentration property in two-dimensional unsteady compressible Euler equations

Yang Xiaozhou

The Innovation Academy for Precision Measurement Science and Technology of the Chinese Academy of Sciences

We will talk about a new definition of measure-valued solutions we propose for the two-dimensional Euler equations with general pressure laws. This generalization of the traditional weak solutions can describe flow fields with properties of high concentrations on mass and momentum. We will also discuss the intrinsic partial differential equations we derive which govern the front surface of the high concentration discontinuities, which can at certain extend be considered as generalization of the classical Rankine-Hugoniot conditions for the Euler equations. We also present some new application results to singular Riemann problems of pressureless Euler equations.

Above results are jointworks with Qihui Gao, Aifang Qu , Hairong Yuan

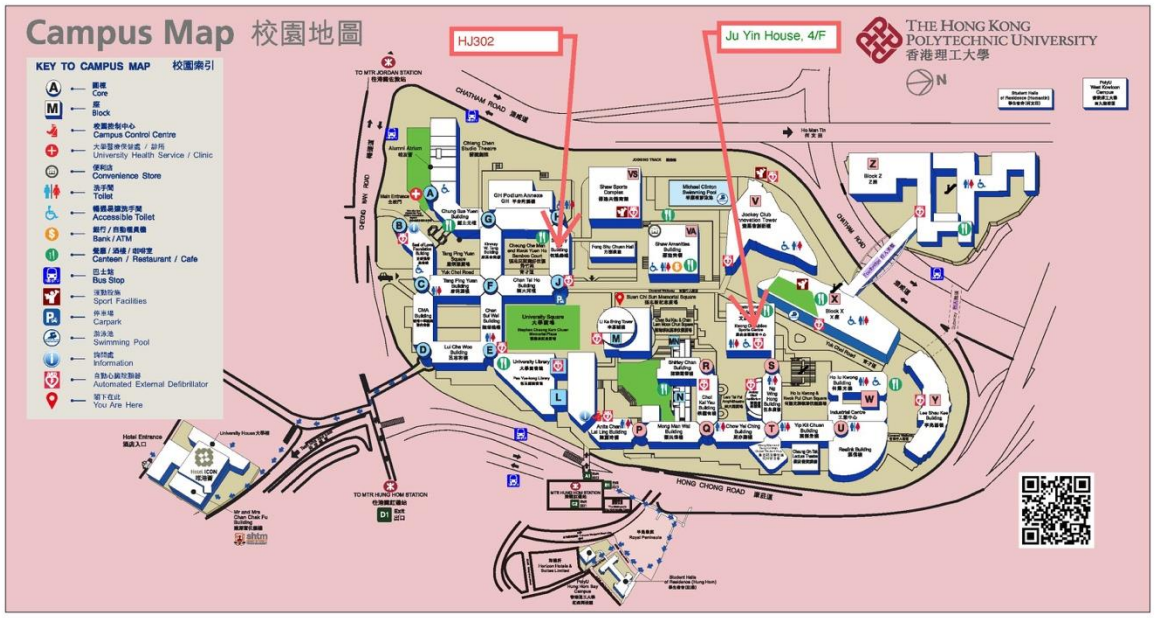
Stability conditions and well-posedness of some free boundary problems

Zhao Wenbin

Renmin University of China

In this talk, we will discuss the Eulerian approach to solve free boundary problems. By deriving the evolution equation of the free surface, we can identity the stability conditions of the problem. Some applications will be served as examples.

Campus Map



[Hong Kong Polytechnic University Campus Map (polyu.edu.hk)]

Acknowledgement

We are very grateful for the financial support and contributions to Workshops in PDEs from Fluid Dynamics as given by

Research Grants Council

The Hong Kong Polytechnic University

Department of Applied Mathematics.

We would also like to thank the staff members in the Department of Applied Mathematics for their time and effort in making this workshop possible during the tight schedule. Their assistance has been indispensable.