MATH 606D Topics in Differential Equations

Inviscid Limit and boundary layer

January - April, 2025
https://personal.math.ubc.ca/~ttsai/courses/606D-25Q1/

Course Description

The validity of the vanishing viscosity limit, that is, whether solutions of the Navier-Stokes equations modeling viscous incompressible flows converge to solutions of the Euler equations modeling inviscid incompressible flows as viscosity approaches zero, is one of the most fundamental issues in mathematical fluid mechanics. The problem is classified into two categories: the case when the physical boundary is absent, and the case when the physical boundary is present and the effect of the boundary layer becomes significant. We will start with the first case and then focus on the second case. In the second case, both no-slip and slip boundary conditions will be considered.

Lecture summaries and some references will be available in a public owncloud folder, whose link will be given to the audience. The link will expire on May 31, 2025.

Prerequisites

MATH 516 or equivalent. Other relevant materials will be reviewed during the course.

References

1. D. Gerard-Varet, Y. Maekawa, and N. Masmoudi, Gevrey stability of Prandtl expansions for 2D Navier-Stokes, Duke Math. J., 167 (2018), pp. 2531-2631.
2. Y. Maekawa and A. Mazzucato, The inviscid limit and boundary layers for Navier-Stokes flows, in Handbook of Mathematical Analysis in Mechanics of Viscous Fluids, Y. Giga and A. Novotny, eds., Springer, Cham, 2018, pp. 781-828.
3. T. T. Nguyen and T. T. Nguyen, The inviscid limit of Navier-Stokes equations for vortex-wave data on R^2, SIAM J. Math. Anal., 51 (2019), pp. 2575-2598
4. T.-P. Tsai, Lectures on Navier-Stokes equations, AMS GSM 192, 2018
5. C. Wang, Y. Wang, and Z. Zhang, Zero-viscosity limit of the Navier-Stokes equations in the analytic setting, Arch. Ration. Mech. Anal., 224 (2017), pp. 555-595.

More references will be added during the term.

Evaluation

The course evaluation will be based on presentation. I will make a list of papers for you to choose from, and provide you the electronic files.

Instructor and lectures

Instructor: Dr. Tai-Peng Tsai, Math building room 109, phone 604-822-2591, ttsai at math.ubc.ca.

Lectures: MATH building room 202, Tue Thu 2pm (I may try to move the days to Mon Wed Fri as I also teach an undergraduate course on Tue Thu 11am)

Office hours: TBA, and by appointment.

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