

Joint Workshop on Analysis of PDEs

2024-12-23 18:00-21:00

Zoom meeting #: 87074532031 password: 241223

Zoom link: <https://us02web.zoom.us/j/87074532031>

Schedule

Time	Speaker	Chair
18:05-18:35	Henrik Shahgholian	Yachun Li
18:40-19:10	Deng Zhang	
19:15-19:45	Masoud Bayrami	Morteza Fotouhi
19:50-20:20	Chunjing Xie	
20:25-20:55	Yue-Jun Peng	Henrik Shahgholian

Abstracts

Bernoulli's Free Boundary Problem for the p-Laplace Operator

Masoud Bayrami

University of Tehran, Iran

The (one-phase) Bernoulli problem deeply influenced the modern free boundary regularity theory and is still an object of intensive research. Free boundary problems (or briefly FBPs) are often PDE-described problems with a priori unknown (free) interfaces or boundaries. Such types of problems appear in Physics, Geometry, Probability, Biology, or Finance, and the study of solutions and free boundaries uses methods from Partial Differential Equations (PDEs), Calculus of Variations (COVs), and Geometric Measure Theory (GMT). We first review the very classical theory, which is about how to understand the regularity of free boundaries. We then discuss recent findings related to the two-phase Bernoulli problem involving the p-Laplace operator, as well as the optimal Lipschitz regularity in the case of one-phase vectorial almost-minimizer solutions.

Global large smooth solutions and relaxation limit of isothermal Euler equations

Yue-Jun Peng

University of Clermont Auvergne, France

In this talk, I show that the Cauchy problem for isothermal Euler equations with relaxation admits a unique global smooth solution when either the relaxation time or the initial datum is sufficiently

smallThe large smooth solution is then obtained when the relaxation time is sufficiently small. Moreover, establish error estimates for the convergence of the large density of the Euler equations toward the solution of the heat equation as the relaxation time tends to zero. Besides classical energy estimates, a uniform estimate for a quantity related to Darcy's law is important in the proof of the above results.

Constraint Maps and their free boundaries

Henrik Shahgholian

KTH, Sweden

I will provide an introduction to the topic of constraint maps, which lies at the intersection of free boundary problems and harmonic maps. The talk will begin at a graduate level and will gradually incorporate recent developments and ongoing work. This presentation is based on current collaborations with A. Figalli, A. Guerra, and S. Kim. For a gentle introduction to the topic, see <https://arxiv.org/pdf/2411.04110>."

Rigidity for steady incompressible Euler flows and its applications

Chunjing Xie

Shanghai Jiao Tong University, China

Stagnation of flows is an interesting phenomenon in fluid mechanics. It induces many challenging problems in analysis. First, we give a classification of incompressible Euler flows via the set of flow angles. Second, we classify the analytic flows in a simply connected bounded domain.

Recent results on non-uniqueness of (hyper-viscous) Navier-Stokes equations and MHD system

Deng Zhang

Shanghai Jiao Tong University, China

In this talk we will review some recent results on the non-uniqueness issue of 3-D Navier-Stokes (NS) equations and magnetohydrodynamic (MHD) equations. First, it is shown that, even in the hyper-viscous regime beyond the Lions exponent, the uniqueness of weak solutions to NS equations and MHD system would fail in certain mixed Lebesgue spaces, which are supercritical with respect to the Ladyzenskaja-Prodi-Serrin criterion. The constructed solutions can be close to the unique Leray-Hopf solutions and admit the spatial regularity. Furthermore, for the classical NS equations, we also show that for any prescribed finite energy initial data, there exist infinitely many global weak solutions with continuous energy profiles.
