ABSTRACT OF TALKS

Jishan Fan

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"Regularity conditions of Navier-Stokes equations"

A logarithmically improved regularity criterion in Besov space is given for Navier-Stokes equations, which improved the result of Kozono-Ogawa-Taniuchi. The proof uses a new inequality of Y. Meyer. This is a result based on a joint work with Professor Tohru Ozawa.

Dario Götz

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"Temporal semi-discretization of the equations describing generalized Newtonian fluids"

In this talk, the existence of weak solutions to the instationary equations of motion for incompressible fluids with shear-rate dependent viscosity is investigated using a temporal semi-discretization. Under the assumption of a p-structure for the deviatoric stress tensor, several situations resulting from values for the parameter p are discussed. The Lipschitz-truncation method is employed to treat the problems arising from the lack of regularity of the solution's time-derivative. For this, a proof of boundedness of the approximating sequence in suitable fractional order spaces is essential.

Tobias Hansel

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"Non-autonomous Ornstein-Uhlenbeck type operators in exterior domains"

Time-dependent Ornstein-Uhlenbeck type operators, formally defined by

$$\mathcal{L}(t)u(x) := \Delta u(x) + \langle M(t)x + c(t), \nabla u(x)\rangle, \qquad t \in \mathbb{R}_+, \quad x \in \Omega,$$

are considered in smooth exterior domains $\Omega \subset \mathbb{R}^d$ subject to Dirichlet boundary conditions. Operators of this type arise in the study of the Navier-Stokes flow in the exterior of a rotating obstacle with a general time-dependent angular velocity and a general prescribed outflow condition at infinity.

It is shown that under suitable assumptions on the coefficients, the solution of the corresponding non-autonomous parabolic problem is governed by an evolution system

on $L^p(\Omega)$ for $1 < p < \infty$. Furthermore, L^p-estimates for spatial derivatives and L^p-L^q smoothing properties for the evolution system are obtained.

Tatsuo Iguchi

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"A mathematical analysis of tsunami generation in shallow water due to seabed deformation"

In numerical simulation of tsunamis due to submarine earthquakes, one usually uses the shallow water equations by assuming that the initial displacement of water surface is equal to the permanent deformation of seabed and that there is no initial velocity field. In this talk, starting from the full water wave problem (a free boundary problem for an irrotational flow of an incompressible ideal fluid under the gravitational field) we derive mathematically rigorously the shallow water model mentioned above, that is, we will show that the solution of the full water wave problem can be approximated by the solution of the shallow water model in some limits of parameters. Moreover, we report that in some case we have to take some initial velocity field, which arises as a nonlinear effect, into account as initial data.

Matthias Köhne

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"On two-phase flows with soluble surfactant – modeling and analysis"

We discuss a model for two-phase flows of inviscid, incompressible Newtonian fluids, in the case where a surface-active-agent is soluted in one of these fluids. The presence of such a surfactant has a pronounced effect on the surface tension of the phase-separating interface, and hence on the stress balance at the interface. The model is derived from continuum mechanical balance equations for mass, momentum and surfactant molar mass and it consists of a system of partial differential equations and interfacial jump conditions, which contains the two-phase Navier-Stokes equations with surface tension as a special case. Based on this mathematical model, an outline of the analysis of the problem in an L_p-setting will be given. This is joint work with Dieter Bothe and Jan Prüß.

Takayuki Kubo

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"Criterion for stability of the stationary solution to the Navier-Stokes equations in half-space"

A criterion is established for stability of the stationary solution to the Navier-Stokes equations in half-space $\mathbb{R}^n_+ (n \geq 2)$. To be precise, our criterion says that the stationary solution is stable if it has the property $(1+x_n)u_s \in L^\infty(\mathbb{R}^n_+)$. In fact, in half-space $\mathbb{R}^n_+ (n \geq 3)$, the stationary solution with the decay property $|u_s| \leq C/|x|^{n-1}$ is constructed if the external force f has the divergence form $f = \nabla \cdot F$ and F has the suitable decay property as $|x| \to \infty$. Our criterion says that the stationary solution is stable.

Yasunori Maekawa

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"Three dimensional stability of the Burgers vortex"

The axisymmetric Burgers vortex is an explicit solution of the three-dimensional Navier-Stokes equations which provides a simple model for the vortex tubes or filaments that are observed in turbulent flows. In this talk we show that the axisymmetric Burgers vortex is asymptotically stable with respect to three-dimensional perturbations for any value of the Reynolds number.

Sylvie Monniaux

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"Navier-Stokes equations in non smooth domains"

In my talk, I will investigate Navier-Stokes equations in a functional setting in 3D open sets, bounded or not, without assuming any regularity of the boundary. The main idea is to find a correct definition of the Stokes operator in a suitable Hilbert space of divergence-free vectors and apply the Fujita-Kato method, a fixed point procedure, to get a local strong solution.

Naoto Nakano

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"On an initial-boundary problem for inhomogeneous incompressible fluid-like bodies"

The talk presents a mathematical analysis on Inhomogeneous Incompressible Fluid-like Bodies (IIFB) which arises from a continuum model for a flow of granular materials. Unlike the usual viscous fluids, the stress depends also on the material inhomogeneity, namely on the gradient of the density of the body. The dependence of the stress on the inhomogeneity may cause the different flow property even in a simple shear flow. Mathematical results on initial-boundary value problems on this topic obtained so far will be also discussed.

Manuel Nesensohn

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"The Dirichlet Laplace operator on Sobolev spaces of higher order"

The Laplace operator in the whole space generates an analytic semigroup in the complete scale of Sobolev spaces. This talk refers to the Dirichlet Laplacian in the half space. The operator generates an analytic semigroup in the L_p-setting, without the possibility to extend this result to Sobolev spaces of higher order. An optimal resolvent estimate, an estimate in parameter-depending norms and a positive result in spaces with additional boundary conditions for this operator are established.

Takahiro Okabe

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"A reproductive property of the time dependent boundary value problem to the Navier-Stokes equations under the general flux condition"

We investigate a reproductive property of the time dependent boundary value problem to the Navier-Stokes equations. We roughly say that Navier-Stokes equations have *the reproductive property* in weak solutions if for any fixed time there exist at least one weak solution whose value of the time attain its initial data again, which may be regarded as a generalization of time periodicity.

Kohei Soga

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"Variational and stochastic characterization of a difference scheme for nonlinear PDEs"

Difference approximation is an effective approach to viscosity solutions of the Hamilton-Jacobi equation corresponding to the inviscid forced Burgers equation. In this talk, it is shown that the difference solutions are represented as the infimum of the expectation of the action functional on the set of sample paths of random walk on the grid. Application of the representation to Hamiltonian dynamics is also discussed.

Christof Trunk

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"On the Navier-Stokes equations with (autonomous) Oseen condition in the exterior of a rotating obstacle"

It is well known that the Navier-Stokes Equations in the exterior of a rotating obstacle admit a local mild solution in the L^p setting. This result is shown by eliminating the

time-dependence of the domain via a time dependent coordinate transformation. By a localization procedure it can be shown that the linearized problem is governed by a strongly continuous semigroup on L^2. The semigroup can be written as an iterated convolution which allows to extend it to L^p, for $1 < p < \infty$. Furthermore certain L^p-L^q estimates for the semigroup can be shown. Finally, the existence of a local mild solution to the problem is proven via Kato's iteration procedure. The same technique allows the treatment of a prescribed outflow velocity at infinity, provided this velocity is a fixed point of the rotation.

Marcus Wunsch

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"Nonlinear evolutions in hydrodynamics"

In this talk, recently obtained results regarding the Proudman-Johnson equation and the Hunter-Saxton system will be presented. It will be shown that solutions to the Proudman-Johnson equation, which corresponds to the axisymmetric two-dimensional Euler equations, preserve certain geometric properties of their initial data. Moreover, using Kato's theory for abstract evolution equations and a lemma due to J. Escher and A. Constantin, local-in-time existence and blow-up phenomena for strong solutions to the Hunter-Saxton system, which can be derived from the governing equations for water waves, will be established.

Tsuyoshi Yoneda

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"Non blow-up of the Navier-Stokes equations in a rotating frame with spatially almost periodic data"

Non blow-up of the Navier-Stokes equations in a rotating frame with spatially almost periodic data is considered. The Coriolis force appears in almost all of the models of oceanography and meteorology dealing with large-scale phenomena. To consider such a problem, FM space is used, i.e. Fourier preimage of the space of all finite Radon measures with no point mass at the origin proposed by Giga, Inui, Mahalov and Matsui in 2005. Non blow-up is proven by means of techniques of fast singular oscillating limits and bootstrapping from a global-in-time unique solution to the extended 2D-Navier-Stokes equations.