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独立行政法人日本学術振興会 日独共同大学院プログラム
JSPS-DFG Japanese-German Graduate Externship

新規発信研究集会
Kickoff Meeting

June 17 - 18, 2014

at Waseda University, Nishi-Waseda Campus
63 Bldg. 2nd Floor - 05 Conference Room

■ Program ■

Tuesday, June 17	
10:00 | 10:30	Opening Remarks
10:40 | 11:30	Reinhard FARWIG (TU Darmstadt)
11:40 | 12:30	Yoshiyuki KAGEI 隠居良行 (Kyushu University)
Lunch Break	
14:30 | 15:20	Ulrich KOHLENBACH (TU Darmstadt)
Coffee Break	
15:50 | 16:40	Shuichi KAWASHIMA 川島秀一 (Kyushu University)

Wednesday, June 18	
10:00 | 10:50	Yoshikazu GIGA 儀我美一 (the University of Tokyo)
11:00 | 11:50	Toshiaki HISHIDA 菱田俊明 (Nagoya University)
Lunch Break	
14:00 | 14:50	Mitsuru SUGIMOTO 杉本充 (Nagoya University)
15:00 | 15:50	Masao YAMAZAKI 山崎昌男 (Waseda University)
Coffee Break	
16:20 | 17:10	Yoshihiro SHIBATA 柴田良弘 (Waseda University)
17:20	Closing Remarks

18:00 ～	Reception

Reinhard FARWIG
Technical University of Darmstadt, Darmstadt

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Title:

The fundamental solution of compressible and incompressible fluid flow past a rotating obstacle

Abstract:

We consider the flow of either an incompressible or a compressible fluid around or past a rotating rigid body in the whole space $\mathbb{R}^3$. Using a global coordinate transform and a linearization the problem reduces to a linear PDE system in a time-independent domain which may admit stationary solutions. For the new system on $\mathbb{R}^3$ – with a virtual obstacle – we are looking for the fundamental solution and its estimates in L^q-space.

In the incompressible case the fundamental solution has been found by T. Hishida, D. Müller and myself via Fourier transformation and estimated in L^q-space for all $q \in (1, \infty)$, see [1, 2]. Although in the compressible case the same strategy leads to an explicit solution in Fourier space, the corresponding multiplier function shows a very different behaviour: it is not smooth outside of the origin so that usual L^q-estimates are not at all obvious. Actually, we need a restriction on q, see [3].

References:

[1] R. Farwig, T. Hishida, D. Müller: *L^q-Theory of a Singular "Winding" Integral Operator Arising from Fluid Dynamics.* Pacific J. Math. 215, 297–312 (2004)

[2] R. Farwig: *An L^q–analysis of Viscous Fluid Flow past a Rotating Obstacle.* Tôhoku Math. J. 58, 129–147 (2005)

[3] R. Farwig, M. Pokorný: *A Linearized Model for Compressible Flow past a Rotating Obstacle: Analysis via Modified Bochner–Riesz Multipliers.* FB Mathematik, TU Darmstadt, Preprint no. 2682 (2014)

Date:

Tuesday, June 17 10:40-11:30

Yoshikazu GIGA
The University of Tokyo, Tokyo

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Title:

On the stokes semigroup in some non-Helmholtz domains

Abstract:

It is well-known that the Stokes operator associated with the Stokes equations generates analytic semigroups in L^p type space in various domains. Recent study shows that the Stokes operator not only generates an analytic semigroup but also enjoy maximal regularity property provided that domain admits the Helmholtz decomposition in L^p. Unfortunately, there are domains that the Helmholtz decomposition fails.

In this talk we would like to give an example that the Stokes operator generates an analytic semigroup in L^p type for some two-dimensional domains where the L^p Helmholtz decomposition is not allowed.

Our method appeals to L^∞ theory, which is recently established in various domains including a bounded domain, an exterior domain and a perturbed half space. It turns out that our method applies to some non-Helmholtz domains as well as cylindrical domains. However, a recent study of Lorenz von Below shows that a three- or higher dimensional layer domain does not permit L^∞ theory. This is a joint work in progress with Ken Abe, Katharina Schade and Takuya Suzuki.

Date:

Wednesday, June 18 10:00-10:50

Toshiaki HISHIDA
Nagoya University, Nagoya

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Title:

Stability of time-dependent Navier-Stokes flow and algebraic energy decay

Abstract:

Let $V = V(x,t)$ be a given time-dependent Navier-Stokes flow of an incompressible viscous fluid in the whole space $\mathbb{R}^3$. As important examples of this basic flow V, we have the following in mind: forward self-similar solution, time-periodic solution and global mild (eventually strong) solution of the Cauchy problem. It is thus reasonable to assume that $V \in L^\infty(0,\infty; L^{3,\infty}) \cap C_w([0,\infty); L^{3,\infty})$, where $L^{3,\infty}$ denotes the weak-L^3 space. The energy stability of small V in this class with respect to any initial disturbance in L^2_σ has been recently investigated by Karch, Pilarczyk and Schonbek. It would be interesting to find how fast the disturbance decays in L^2 as $t \to \infty$ when the initial disturbance possesses better summability at space infinity. In this presentation it is proved that any weak solution $u(x,t)$ with the strong energy inequality to the perturbed Navier-Stokes system, which the disturbance should obey, enjoys $\|u(t)\|_2 = O\big(t^{-\frac{3}{2}(1/q-1/2)}\big)$ as $t \to \infty$ provided the initial disturbance is taken from $L^q \cap L^2_\sigma$ for some $q \in [1,2)$. The proof relies on a development of the Fourier splitting method combined with L^q-L^r estimate of the evolution operator generated by the linearized operator around the basic flow V.

This talk is based on a joint work with Maria E. Schonbek (University of California, Santa Cruz).

Date:

Wednesday, June 18 11:00-11:50

Yoshiyuki KAGEI
Kyushu University, Fukuoka

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Title:

On asymptotic behavior of solutions to the compressible Navier-Stokes equation in a periodic layer

Abstract:

We consider the following compressible Navier-Stokes equation

$$\begin{cases} \partial_t \rho + \operatorname{div}(\rho u) = 0, \\ \rho(\partial_t v + v \cdot \nabla v) - \mu \triangle v - (\mu + \mu')\nabla \operatorname{div} v + \nabla(P(\rho)) = 0, \\ v|_{\partial\Omega} = 0, \\ (\rho, v)|_{t=0} = (\rho_0, v_0). \end{cases} \tag{1}$$

Here Ω is a periodic layer in $\mathbb{R}^n$:

$$\Omega := \left\{ x = (x', x_n); x' \in \mathbb{R}^{n-1}, \omega_1(x') \le x_n \le \omega_2(x') \right\},$$

where $\omega_1,\ \omega_2$ are smooth functions satisfying

$$\omega_j(x' + \boldsymbol{a}_i') = \omega_j(x') \ (j = 1, 2\ ;\ i = 1, \cdots, n-1)$$

for all $x' \in \mathbb{R}^{n-1}$ with $\vec{a}_i'$ $(i = 1, \cdots, n-1)$ given by constant vectors $\vec{a}_i' = \frac{2\pi}{\alpha_i}\vec{e}_i$, $\vec{e}_i' = {}^T(0, \cdots, \overset{i}{1}, \cdots, 0) \in \mathbb{R}^{n-1}$; μ and μ' are the viscosity coefficients that satisfy $\mu > 0$, $\frac{2}{n}\mu + \mu' \ge 0$; and P is the pressure that is a smooth function of ρ. We assume that

$$P'(\rho_*) > 0$$

for a given positive constant ρ_*.

We discuss large time behavior of solutions to (1) around the constant state $(\rho_*, 0)$. It will be shown that the L^2 norm of the perturbation $(\rho(t) - \rho_*, v(t))$ decays in the order $O(t^{-\frac{n-1}{4}})$ as $t \to \infty$ if the initial perturbation $(\rho_0 - \rho_*, v_0)$ is sufficiently small; in fact, $(\rho(t) - \rho_*, v(t))$ behaves diffusively in large time.

Date:

Tuesday, June 17 11:40-12:30

Shuichi KAWASHIMA
Kyushu University, Fukuoka

Faculty of Mathematics, Kyushu University

Title:

Dissipative structure for symmetric hyperbolic systems with relaxation

Abstract:

We discuss the dissipative structure and the corresponding decay property for a class of symmetric hyperbolic systems with relaxation. The Shizuta - Kawashima stability condition gives the characterization of the standard dissipative structure for systems with symmetric relaxation. Recently, we found several intereting systems with non-symmetric relaxation which have different dissipative structure. In this talk, we first review the standard theory based on the Shizuta-Kawashima condition. Then we discuss those new examples whose decay structure is of the regularity-loss type. Finally, we report the recent progress on the stability theory for a class of symmetric hyperbolic systems with non-symmetric relaxation.

A part of this talk is based on the joint works with Yoshihiro Ueda, Renjun Duan, and Naofumi Mori.

Date:

Tuesday, June 17 15:50-16:40

Ulrich KOHLENBACH
Technical University of Darmstadt, Darmstadt

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Title:

Logical extraction of effective bounds in nonlinear analysis: metastability and abstract Cauchy problems

Abstract:

During the last two decades a systematic program of 'proof mining' emerged which uses tools from mathematical logic (so-called proof interpretations) to systematically extract explicit quantitative information (e.g. rates of convergence) from prima facie nonconstructive proofs (e.g. convergence proofs). This has been applied particularly successful in the context of nonlinear analysis (fixed point theory, ergodic theory, topological dynamics, see e.g. [2]).

Together with my PhD student A. Koutsoukou-Argyraki in the IRTG 1529, we recently adapted this approach to results on the asymptotic behavior of solutions of abstract Cauchy problems ([1]) that are given by suitable forms of accretive operators in Banach space ([3]).

References:

[1] García-Falset, J., The asymptotic behavior of the solutions of the Cauchy problem generated by ϕ-accretive operators. J. Math. Anal. Appl. **310**, pp. 594-608, 2005.

[2] Kohlenbach, U., Applied Proof Theory: Proof Interpretations and Their Use in Mathematics. Springer Monograph in Mathematics. xx+536pp., 2008.

[3] Kohlenbach, U., Koutsoukou-Argyraki, A., Rates of convergence and metastability for abstract Cauchy problems generated by accretive operators. Preprint 2014.

Date:

Tuesday, June 17 14:30-15:20

Yoshihiro SHIBATA
Waseda University, Tokyo

Title:

Compressible and Incompressible two phase problem including the phase transition problem

Abstract:

In this talk, I would like to talk about the local wellposedness of the incompressible-compressible two phase problem with sharp interface. The problem is described as a certain free boundary problem.

To talk about the main point of my talk, forgetting the Fourier part, I would like to talk about the Navier-Stokes part. Without phase transition case, I transfer the problem to the problem in the fixed domain by the Lagrange transform. The main point of my approach is to prove the maximal L_p - L_q regularity for the linearized equations. Then, I have the local wellposedness without any restriction of the size of the initial data.

On the other hand, with phase transition case, we can not use the Lagrange transform, so that I have to use so called Hanzawa transform to transform the problem to the fixed domain. Then, the mass density beeing represented by the velocity field in the compressible part, we transfer the problem to the nonlinear Lame-system in the compressible parts and Navier-Stokes equations in the incompressible part with suitable jump condition and one more equations on the interface. I also prove the maximal L_p - L_q regularity for the linearized equations, but the local well-posedness holds only for the small initial data because of the Hanzawa transform.

The main part of my talk is devoted to explaining the analysis of the Lopatinski determinant for the model problem. Because, nowadays once getting the maximal regularity for the model problem, it is rather well-known to prove local wellposedness for the quasilinear equations with help of maximal regularity for the linearized equations.

The essential difference in the model problem between the without phase transition and with phase transition is the following: Without phase transition, we have to treat the difference of the normal component of the velocity fields through the interface, but with phase transition, this part is given as the phase transition, but we have one more condition written with the first order partial differential equations.

Date:

Wednesday, June 18 16:20-17:10

Mitsuru SUGIMOTO
Nagoya University, Nagoya

Title:

On a systematic understanding of smoothing estimates for water wave equations

Abstract:

Since a pioneering work of T. Kato which established a smoothing estimate for generalized Korteweg-de Vries equations, smoothing effect for dispersive equations, including many other kind of water wave equation, has been intensively investigated in the last three decades. Such analysis is particularly important in applications to nonlinear evolution equations, especially to those with derivatives in the nonlinearity.

This talk describes a new approach to global smoothing problems for dispersive and non-dispersive evolution equations based on the global canonical transforms and the underlying global microlocal analysis. For this purpose, the Egorov-type theorem is established with canonical transformations in the form of a class of Fourier integral operators, and their mapping properties are derived. This allows us to globally reduce general dispersive equations to normal forms in one or two dimensions. Then, a new comparison principle for evolution equations is introduced. In particular, they allow us to relate different smoothing estimates by comparing certain expressions involving their symbols. As a result, it is shown that the majority of smoothing estimates for different equations are equivalent to each other. Moreover, new estimates as well as several refinements of known results are obtained. The proofs are considerably simplified. A comprehensive analysis is presented of smoothing estimates for dispersive and also non-dispersive equations with constant coefficients. Applications are given to the detailed description of smoothing properties of Korteweg-de Vries, Benjamin-Ono, Davey-Stewartson, Shrira, and other equations.

This is joint work with Michael Ruzhansky (Imperial College London).

Date:

Wednesday, June 18 14:00-14:50

Masao YAMAZAKI
Waseda University, Tokyo

Title:

Two-dimensional Navier-Stokes exterior problem with some symmetry conditions

Abstract:

This talk is concerned with the statonary Navier-Stokes equations on the whole plane or on the two-dimensional exterior domain with nontrivial external forces and the boundary values.

The existence of solutions of this problem is proved under symmetry of two coordinate axes. However, the existence of stationary solutions with decay sufficient for the uniqueness and the stability (which correspond with the physically reasonable solutions in the three-dimensional problem) is proved only under more stringent decay conditions.

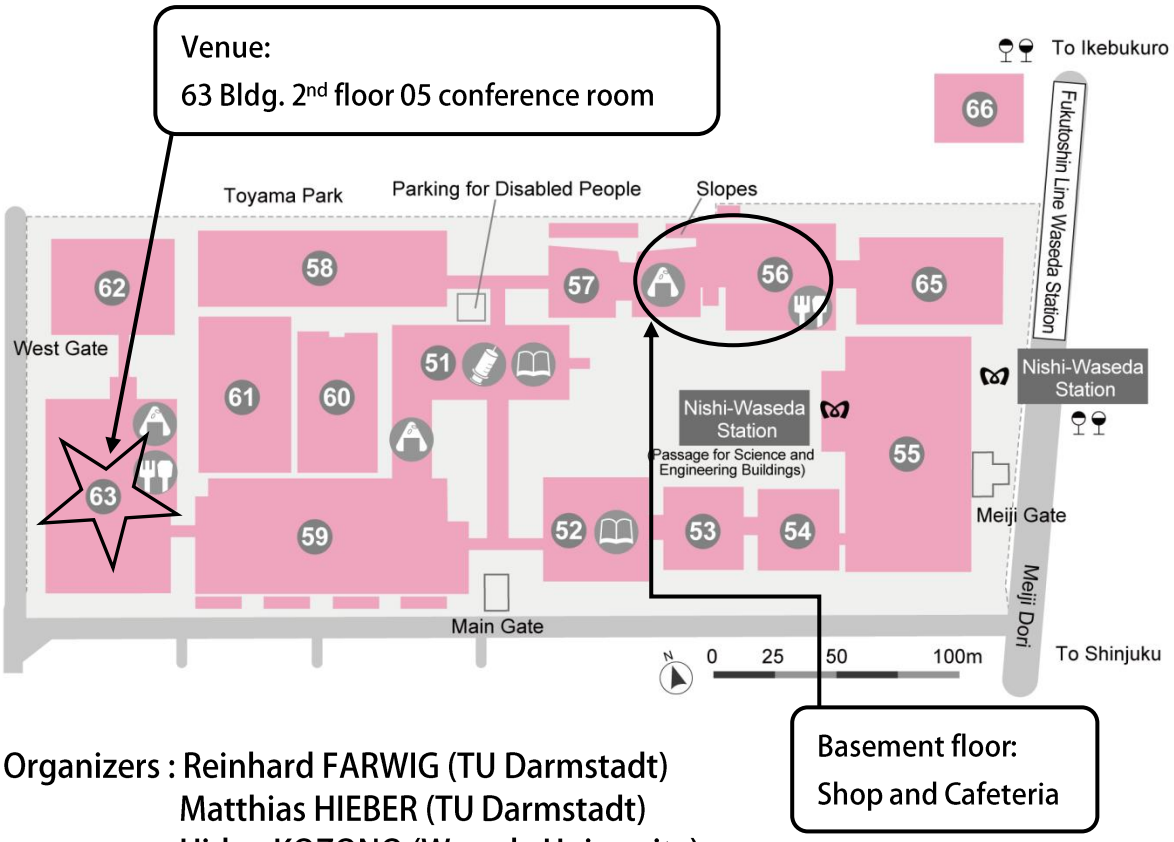
In this talk we give a new condition on the symmetry sufficient for the existence of stationary solutions with adequate decay conditions. This condition generalized the aforementioned strong conditions, and neither necessary nor sufficient for the symmetry of coordinate axes. We emphasize that the new condition is independent of the choice of coordinate axes, and can naturally include the solutions with rotational symmetry.

The uniqueness in the large and the stability under initial L^2-perturbation of the stationary solutions are also discussed.

Date:

Wednesday, June 18 15:00-15:50

Nishi-Waseda Campus Map



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