4th EAST ASIAN CONFERENCE IN HARMONIC ANALYSIS AND APPLICATION

August 1 – 5, 2016
Yonsei University, Science Hall (Rooms 111, 225, 227 and 254)

Organizing committee : Joonil Kim (Yonsei University), Sanghyuk Lee (Seoul National University), Guozhen Lu (Wayne State University), Akihiko Miyachi (Tokyo Woman's Christian University), Masami Okada (Tokyo Metropolitan University)

PROGRAM

August 1 (Monday)

Morning Session (Science Hall Room 111)

09:00–09:30 **Registration and opening**

09:30–10:10 **Mitsuru Sugimoto** (Nagoya University)
A criterion for the global boundedness of locally bounded integral operators

10:20–11:00 **Hong-Quan LI** (Fudan University)
Sharp endpoint estimates for some operators related to the Laplacian with drift

11:20–12:00 **Chanwoo Yang** (Korea University)
Average along holomorphic curves

12:00–14:30 **Lunch**

Session A (Sicence Hall Room 225)

14:30–15:00 **Shaoming Guo** (Indiana University Bloomington)
Decoupling inequalities related to Vinogradov's mean value theorems in dimension two and three

15:10–15:40 **Satoshi Masaki** (Osaka University)
Minimization problems on non-scattering solutions to mass-subcritical NLS euqation

16:00-16:30 **Ihyeok Seo** (Sungkyunkwan University)
Improved Strichartz estimates in weighted L^2 spaces and their applications

16:40–17:10 **Shohei Nakamura** (Tokyo Metropolitan University)
Integral operators on weighted Morrey spaces

Session B (Sicence Hall Room 227)

14:30–15:00 **Qingying Xue** (Beijing Normal University)
On the boundedness of bi-parameter Littlewood-Paley operators

15:10–15:40 **Denny Ivanal Hakim** (Tokyo Metropolitan University)
Complex interpolation of grand Lebesgue spaces

16:00–16:30 **Chuhee Cho** (Seoul National University)
Improved restriction estimate for hyperbolic surfaces in $\mathbb{R}^3$

16:40–17:10 **Jayson Cuanan** (Shinshu University)
Trace theorems on Wiener amalgam spaces

August 2 (Tuesday)

Morning Session (Science Hall Room 111)

09:30–10:10 **Takeshi Kawazoe** (Keio University)
Weak L^1 estimate of the Hardy-Littlewood maximal operator for the Jacobi hypergroup

10:20–11:00 **Zhifei Zhang** (Peking University)
Linear damping in the inviscid flow

11:20–12:00 **Yong-Kum Cho** (Chung-Ang University)
Fourier transforms of radial measures and Hankel-Schoenberg transforms

12:00–14:30 **Lunch**

Session A (Sicence Hall Room 225)

14:30–15:00 **Qiaohua Yang** (Wuhan University)
Hardy-Trudinger-Moser and Hardy-Adams inequalities on hyperbolic spaces

15:10–15:40 **Hiroki Saito** (Kogakuin University)
The Fefferman-Stein type inequality for the directional maximal operator

16:00-16:30 **Changkeun Oh** (Postech)
Decouplings for d-dimensional surfaces in $\mathbb{R}^{2d}$

16:40-17:10 **Yongping Liu** (Beijing Normal University)
Best restriction approximation by entire functions of exponential type

Session B (Sicence Hall Room 227)

14:30–15:00 **Satoko Sugano** (Kobe City College of Technology)
L^p boundedness of higher order Schrödinger type operators

15:10–15:40 **Yoshihiro Sawano** (Tokyo Metropolitan University)
Complex interpolation of Morrey spaces

16:00–16:30 **Chulkwang Kwak** (Kaist)
Local well-posedness of the fifth-order periodic modified KdV equation

16:40–17:10 **Jiman Zhao** (Beijing Normal University)
New Abstract H^p spaces

17:30–19:30 **Banquet** (Allen House)

August 3 (Wednesday)

Free Discussion (Science Hall Room 254)

August 4 (Thursday)

Morning Session (Science Hall Room 111)

09:10–09:50 **Soonsik Kwon** (KAIST)
Normal form approach to global well-posedness of quadratic derivative nonlinear Schrodinger equation

10:00–10:40 **Chengbo Wang** (Zhejiang University)
The radial Glassey conjecture with minimal regularity

11:00–11:40 **Hitoshi Tanaka** (Tsukuba University of Technology)
The n linear embedding theorem

11:50–12:30 **Guozhen Lu** (Wayne State University)
Sharp constants and extremal functions for Caffarelli-Kohn-Nirenberg and Trudinger-Moser inequalities

12:30–14:30 **Lunch**

Session A (Sicence Hall Room 225)

14:30–15:00 **Yifei Wu** (Tianjin University)
The defocusing energy-supercritical nonlinear wave equation

15:10–15:40 **Takahiro Noi** (Tokyo Metropolitan University)
Non smooth atomic decomposition for Generalized Besov Morrey spaces

16:00–16:30 **Joris Roos** (University of Bonn)
Polynomial Carleson operators along monomial curves in the plane

16:40-17:10 **Daewon Chung** (Keimyung University)
Quantitative two weight estimates for the dyadic square function

Session B (Sicence Hall Room 227)

14:30–15:00 **Junfeng Li** (Beijing Normal University)
Well-posedness of the Kadomtsev-Petviashvili initial data problem

15:10–15:40 **Youngwoo Koh** (KIAS)
Wolff's cone restricted X-ray estimate in $\mathbb{R}^3$

16:00–16:30 **Guantie Deng** (Beijing Normal University)
Rational Approximation of Functions in Hardy Spaces

16:40–17:10 **Seungwoo Kuk** (Yonsei University)
L^2 estimates for certain oscillatory singular integrals with variable flat phases.

August 5 (Friday)

Morning Session (Science Hall Room 111)

09:30–10:10 **Hantaek Bae** (UNIST)
Transport equation with nonlocal velocity

10:20–11:00 **Lixin Yan** (Sun Yat-sen University)
Multicommutators And Multiplier Theorems

11:20–12:00 **Neal Bez** (Saitama University)
Stability of the Brascamp-Lieb constant and applications

12:00–12:10 **Closing**

ABSTRACTS

(In alphabetical order of speaker's last name)

Transport equation with nonlocal velocity

Hantaek Bae

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We consider 1D equations with nonlocal velocity field

$$\theta_t + u\theta_x - \delta u_x \theta + \Lambda^\gamma \theta = 0 \tag{1}$$

where $u = \mathcal{N}(\theta)$ is given by one of the form

(1) $u = \mathcal{H}\theta$;
(2) $u = (1 - \partial_{xx})^{-\alpha}\theta$.

In this talk, we address the existence of weak solutions of (1). When $0 < \gamma < 1$, we take initial data having finite energy. When $\gamma = 1$, we take initial data having infinite energy involving Muckenhoupt weights.

Stability of the Brascamp-Lieb constant and applications

Neal Bez

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The Brascamp-Lieb inequality is a natural and powerful generalisation of several fundamental inequalities, including the multilinear Hölder inequality, the Loomis-Whitney inequality and the Young convolution inequality. In this talk we discuss the stability of the inequality under perturbations of the underlying linear mappings, along with applications to multilinear restriction and Kakeya inequalities, as well as nonlinear extensions of the Brascamp-Lieb inequality. The talk is based on joint work with Jonathan Bennett, Michael Cowling, Taryn Flock and Sanghyuk Lee.

Improved restriction estimate for hyperbolic surfaces in $\mathbb{R}^3$

Chuhee Cho

Seoul National University, akilusius@gmail.com

Improved restriction estimate for hyperbolic surfaces in $\mathbb{R}^3$: In this talk we consider the surfaces with strictly negative Gaussian curvature and restriction problem for the surface. We improve restriction estimate to the surfaces using polynomial partitioning.

Fourier transforms of radial measures and Hankel-Schoenberg transforms

Yong-Kum Cho

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In many areas of Mathematics, the theory of radial positive definite functions constitutes the core subject to study. By extending the radial Fourier transforms, we study radial positive definite functions by means of the Hankel-Schoenberg transforms

$$\int_0^\infty \Omega_\lambda(rt)d\nu(t)\,, \quad \Omega_\lambda(t) = \Gamma(\lambda+1)\left(\frac{t}{2}\right)^{-\lambda} J_\lambda(t)\,,$$

on the class of probability measures supported on $[0,\infty)$, where J_λ denotes the Bessel function of order $\lambda \geq -1/2$.

Our emphases will be put on the following topics:

(i) To construct a large family of radial positive definite functions including compactly supported ones.
(ii) To construct explicit Riesz sequences on $L^2(\mathbb{R}^n)$.
(iii) To clarify how the dimension walks take place in the radial Fourier transforms.

Quantitative two weight estimates for the dyadic square function

Daewon Chung
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We will present recent results about two weight inequalities for the dyadic square function and necessary and sufficient conditions for its boundedness. More precisely we show conditions on pairs of locally integrable a.e. positive functions (u, v) so that the dyadic square function is bounded from $L^2(u)$ into $L^2(v)$, that is there exists a constant $C_{u,v} > 0$ such that for all $f \in L^2(u)$,

$$\|Sf\|_{L^2(v)} \leq C_{u,v}\|f\|_{L^2(u)}\,,$$

with estimates on $C_{u,v}$ involving the constants that appear in the conditions imposed on the weights.
We also obtained a quantitative two-weight estimate for π_b, the dyadic paraproduct associated to b, where $b \in Carl_{u,v}$ a new class of functions that we show coincides with BMO when $u = v \in A_2$. The sufficient conditions on the pair of weights (u, v) required in our theorem are half of the conditions required for the boundedness of the martingale transform, namely (i) $(u, v) \in A_2$ (joint A_2 condition) and (ii) a Carleson condition on the weights, or equivalently the conditions required for the boundedness of the dyadic square function from $L^2(v^{-1})$ into $L^2(u^{-1})$.
Comparison with the known two weight results for the martingale transform, the dyadic square function, and the dyadic maximal function will be discussed. Assuming the maximal operator is bounded from $L^2(u)$ into $L^2(v)$, and under the additional condition that v is in the RH_1^d class, we conclude the other operators are bounded with quantitative estimates involving the operator norm of the maximal function and the RH_1^d constant. Notice that the boundedness of the maximal function implies that the weights (u, v) obey the joint A_2^d condition, but that is not sufficient for boundedness.
Finally, we show quantitative estimates for the dyadic square function when $(u, v) \in A_2^d$ and u^{-1} is in RH_1^d.

Trace theorems on Wiener amalgam spaces

Jayson Cunanan
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We discuss the trace operators of Wiener amalgam spaces using frequency-uniform decomposition operators and maximal inequalities, obtaining sharp results. Additionally, we provide the embeddings between standard and anisotropic Wiener amalgam spaces.This talk is based on collaborated work with Y. Tsutsui.

Rational Approximation of Functions in Hardy Spaces

Guantie Deng
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We present some results on rational approximation, integral representation and Fourier spectrum characterization of functions in the Hardy Spaces. First we show that the set of rational functions in $H^p(\mathbb{C}_{+1})$ with the poles in $\{-i\}$ is dense in $H^p(\mathbb{C}_{+1})$ for $0 < p < \infty$. Secondly, $0 < p < 1$, through rational function approximation we show that any function f in $L^p(\mathbb{R})$ with such range of p can be decomposed into a sum $g+h$, where g and h are, in the $L^p(\mathbb{R})$ sense, the non-tangential boundary limits of functions in $H^p(\mathbb{C}_{+1})$ and $H^p(\mathbb{C}_{-1})$, where $H^p(\mathbb{C}_k)$ $(k = \pm 1)$ are the Hardy spaces in the half plane $\mathbb{C}_k = \{z = x+iy : ky > 0\}$.

Secondly, we give Laplace integral representation formulas for functions in the Hardy spaces H^p, $0 < p \leq 2$. Besides what is shown by the integral representation formula we give another version of Fourier spectrum characterization for functions in the boundary Hardy spaces H^p for $0 < p \leq 1$. Finally, Fourier spectrum characterizations of functions in Hardy H^p spaces on tubes for $1 \leq p \leq \infty$ are given , For $F \in L^p(\mathbb{R}^n)$, we show that F

is the non-tangential boundary limit of a function in such a Hardy space, $H^p(T_\Gamma)$, where Γ is an open cone of $\mathbb{R}^n$ and T_Γ is the relevant tube in $\mathbb{C}^n$, if and only if the classical or distributional Fourier transform of F is supported in Γ^*, where Γ^* is the dual cone of Γ. These generalize the results of Stein and Weiss in the same context for $p = 2$, as well as those of Qian et al on the real line for $1 \leq p \leq \infty$. We extend the Poisson and the Cauchy integral representation formulas for the H^2-spaces to the H^p spaces on tubes for $p \in [1, \infty]$.

Decoupling inequalities related to Vinogradov's mean value theorems in dimension two and three

Shaoming Guo

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I will present some sharp l^p L^p decoupling inequalities associated to certain translation and dilation invariant surfaces. These inequalities imply the sharp bounds for the integer solutions of certain system of Diophantine equations.

Complex interpolation of grand Lebesgue spaces

Denny Ivanal Hakim

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In this talk, we discuss the description of the first and second complex interpolations of grand Lebesgue spaces. Unlike the complex interpolation of Lebesgue spaces, the results of these two interpolation methods on grand Lebesgue spaces are two different spaces. We also investigate the complex interpolation of closed subspaces satisfying the lattice property. This is joint work with Mitsuo Izuki (Okayama University) and Yoshihiro Sawano (Tokyo Metropolitan University).

Weak L^1 estimate of the Hardy-Littlewood maximal operator for the Jacobi hypergroup

Takeshi Kawazoe

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For the Jacobi hypergroup $(\mathbf{R}_+, \Delta, *)$, the weak L^1 estimate of the Hardy-Littlewood maximal operator M_{HL} was obtained by W. Bloom and Z. Xu (1995), later by J. Liu (2000). In this talk we shall give an alternative proof based on the inverse Abel transform for the Jacobi analysis. The point is that the Abel transform reduces the convolution $*$ to the Euclidean convolution. Especially, we shall give a standard form of the maximal function $M_{\mathrm{HL}}f$ for $f \in L^1(\Delta)$. Actually, the global part $M^1_{\mathrm{HL}}f$ is estimated as

$$M^1_{\mathrm{HL}}f(x) \leq c\frac{\|f\|_{L^1(\Delta)}}{\Delta(x)}$$

and the local part $M^0_{\mathrm{HL}}f$ is done as

$$M^0_{\mathrm{HL}}f(x) \leq c\frac{\|f\|_{L^1(\Delta)}}{B(x)} + c\sum_{\gamma\in\Gamma_0}\frac{(\tanh x)^\gamma}{\Delta(x)}M^{\mathbf{R},0}_\Phi(e^{\rho x}W^{\mathbf{R}}_{-\gamma}(F))(x),$$

where $W^{\mathbf{R}}_{-\gamma}(F)$ is the Euclidean fractional derivative of the Abel transform F of f, $M^{\mathbf{R},0}_\Phi$ is a local radial maximal operator on $\mathbf{R}$ and $B(x) = \int_0^x \Delta(t)dt$. The weak $L^1(\Delta)$ estimate of M_{HL} easily follows from these estimates.

Wolff's cone restricted X-ray estimate in R^3

Youngwoo Koh
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We study a mixed norm estimate in R^3

$$\left(\int_{S^1} \left(\int_{Y(\omega)} \left| Xf\big(\ell(y,\omega)\big) \right|^r dy \right)^{\frac{q}{r}} d\omega \right)^{\frac{1}{q}} \lesssim \|f\|_{L^p_\alpha(Q)}$$

which proposed by Wolff (2000). Here, $\ell(y,\omega)$ is the line through y with direction $(\omega,1)$, $Y(\omega)$ is a hyperplane perpendicular to $\ell(0,\omega)$ and Q is a unit cube. When the initial data f is in L^p_ϵ, this estimate was completely solved by himself. In this talk, we consider the general $\alpha > 0$ and find some non-trivial ranges of (p,q,r) from some perturbed Kakeya estimate.

L^2 estimates for certain oscillatory singular integrals with variable flat phases.

Seungwoo Kuk
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We are concerned with a certain oscillatory singular integral operator T which has a variable flat phase as the following.

$$Tf(x) = p.v. \int_{\mathbb{R}} e^{iP(x)\gamma(x-y)} \frac{1}{x-y} f(y) dy,$$

where P(x) is a real polynomial of the variable x, and γ has some growth condition. We prove that T is bounded on L2 provided that γ is either odd or even, convex, and γ' has a doubling condition. This improve the result about an oscillatory singular integral operator of J. Bennett in 2002. Moreover, we show that T is bounded on $L^2(\mathbb{R})$ if and only if γ' has a doubling condition, under the assumption that γ is even and convex.

Local well-posedness of the fifth-order periodic modified KdV equation

Chulkwang Kwak
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In this talk, we will discuss about the Cauchy problem of the (integrable) fifth-order modified Korteweg-de Vries (modified KdV) as follows:

$$\begin{cases} \partial_t u - \partial_x^5 u + 40u\partial_x u\partial_x^2 u + 10u^2\partial_x^3 u + 10(\partial_x u)^3 - 30u^4\partial_x u = 0, \quad (t,x) \in \mathbb{R}\times\mathbb{T}, \\ u(0,x) = u_0(x) \in H^s(\mathbb{T}). \end{cases}$$

This equation has a special structure to be solved in the low regularity Sobolev space. Cubic and quintic resonant interaction portions do not make the nonlinear solution behave as a linear solution, so it is required to rely on the integrability property. Moreover, it is imposed to be defined a nonlinear transformation for laying the solution on the exact route. As a technical difficulty, we need to remove new quintic resonant terms in the energy-type estimate. By collecting all ingredients, we will prove the local well-posedness in H^s, $s > 2$, via the standard energy method.

Normal form approach to global well-posedness of quadratic derivative nonlinear Schrodinger equation

Soonsik Kwon
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We will begin with explaining the Poincare-Dulac normal form idea to prove the local well-posedness of nonlinear dispersive equations. Later, we will discuss with a particular example, quadratic derivative NLS. We develop an infinite iteration scheme of normal form reductions for dNLS. By combining this normal form procedure with the (modified) Cole-Hopf transformation, we prove unconditional global well-posedness in $L^2(T)$, and more generally in certain Fourier-Lebesgue spaces $FL^{s,p}(T)$, under the mean-zero and smallness assumptions. With this example, we observe a relation between normal form approach and canonical nonlinear transform.

Sharp endpoint estimates for some operators related to the Laplacian with drift

Hong-Quan Li
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Let $v = (v_1, \cdots, v_n)$ be a vector in $\mathbb{R}^n \setminus \{0\}$. Consider the Laplacian on $\mathbb{R}^n$ with drift $\Delta_v = \sum_{i=1}^n \left(\frac{\partial^2}{\partial x_i^2} + 2v_i \frac{\partial}{\partial x_i} \right)$ and the measure $d\mu(x) = e^{2\langle v,x\rangle} dx$, with respect to which Δ_v is self-adjoint. Let d and ∇ denote the Euclidean distance and the gradient operator on $\mathbb{R}^n$. Consider the space $(\mathbb{R}^n, d, d\mu)$, which has the property of exponential volume growth. We study weak type $(1,1)$ or sharp endpoint estimates for the Riesz transforms, Littlewood-Paley-Stein functions and related maximal operators.

Well-posedness of the Kadomtsev-Petviashvili initial data problem

Junfeng Li
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In this talk, I will present some of the well posedness results on the Kadomtsev-Petviashvili initial data problem. We will consider both the periodic problems and also the non-periodic problems.

Best restriction approximation by entire functions of exponential type

Yongping Liu
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In this paper, we studied the best restriction approximation problems using entire functions of exponential type as the approximation tools on some generalized Sobolev classes of smooth functions defined by the differential operator induced by an algebraic polynomial with only real zeros. By the methods of Fourier transform and periodization, etc, we obtained the exact constants of the average relative widths and the best restriction approximation on the generalized Sobolev classes in the $L_2(\mathbb{R})$ norm, and obtained the asymptotic results of the best restriction approximation on the generalized Sobolev classes in the $L_1(\mathbb{R})$ norm and the uniform norm for the case that the polynomial has a zero of multiplicity at most 2 at the point 0. This is joint work with Bo Ling.

Sharp constants and extremal functions for Caffarelli-Kohn-Nirenberg and Trudinger-Moser inequalities

Guozhen Lu
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In this talk, we will report some recent works on sharp constants and existence of extremal functions of Caffarelli-Kohn-Nirenberg inequalities. We will also discuss the existence and nonexistence of extremal functions for Trudinger-Moser inequalities.

Minimization problems on non-scattering solutions to mass-subcritical NLS euqation

Satoshi Masaki
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We introduce two minimization problems on non-scattering solutions to nonlinear Schrödinger equation. One is a best constant for small data scattering, the other is concerned with a minimal size of "blowup profile.' We can reformulate several previous results in terms of these minimization problems. In mass-critical or -supercritical case, these problems can be considered in Energy space or L^2 space. Our aim is to consider the problem in mass-subcritical, which is the case where a scale critical (homogeneous) Sobolev space has negative regularity. Since there is a difficulty in working with negative regularity, we consider the problems in a Fourier transform of generalized Morrey space. The space naturally arises in the study of improvement of Strichartz estimate (or Stein-Tomas estimate).

Integral operators on weighted Morrey spaces

Shohe Nakamura
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In this talk, we report the recent progress of the weight theory on Morrey spaces, what is the problem solved or still open. The first part relates to the Fefferman-Stein inequality for Morrey spaces. As is well known, the Fefferman-Stein inequality for Lebesgue spaces holds for any weight. However, we realize that the Fefferman-Stein inequality for Morrey spaces does not always holds. So, we investigate the necessary and sufficient condition imposed on the weight for which the Fefferman-Stein inequality for Morrey spaces holds. The second part relates to the boundedness of the integral operators, the singular integral operators and the fractional integral operators, on weighted Morrey spaces. We investigate the problem by assuming the boundedness of the Hardy-Littlewood maximal operator since the problem for the boundedness of the maximal operator is still open. But, we realize the essential difference between the maximal operator and the integral operators on weighted Morrey spaces. We also report the partial answer for the problem related to the boundedness of the maximal operator, time permitting. This talk is a joint work with Professors Takeshi Iida, Yoshihiro Sawano and Hitoshi Tanaka.

Non smooth atomic decomposition for Generalized Besov Morrey spaces

Takahiro Noi
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Nakamura, Noi and Sawano introduced generalized Besov Morrey spaces $\mathcal{N}^{s}_{\mathcal{M}^{\varphi}_{q},r}(\mathbb{R}^n)$ and generalized Triebel–Lizorkin Morrey spaces $\mathcal{E}^{s}_{\mathcal{M}^{\varphi}_{q},r}(\mathbb{R}^n)$. They studied smooth atomic and quarkonical decompositions and trace operator ([2]).

Recently, Gonçaleves and Kempka in [1, Theorem 3.14] considered the non-atomic decomposition for 2-microlocal Besov and Triebel–Lizorkin spaces with variable exponents by slightly adapting the definition of non-smooth atom from Scharf [3].

In this talk, we consider the non-smooth atomic decomposition for generalized Besov Morrey spaces $\mathcal{N}^s_{\mathcal{M}^\varphi_q,r}(\mathbb{R}^n)$. This talk is a joint work with Professor Mitsuo Izuki at Okayama University.

References

1. H. F. Gonçalves, and H. Kempka, *Non-smooth atomic decomposition of 2-microlocal spaces and application to pointwise multiplies.* J. Math. Anal. Appl. **434** (2016), 1875–1890.
2. S. Nakamura, T. Noi and Y. Sawano, *Gereralized Morrey spaces and trace operator.* Sci. China Math. **59** (2016), 281–336.
3. B. Scharf, *Atomic representations in function spaces and applications to pointwise multipliers and diffeorphisms, a new approach.* Math. Nachr. **286** (2013), 283–305.

Decouplings for d-dimensional surfaces in $\mathbb{R}^{2d}$

Changkeun Oh

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The decoupling inequality has a wide range of applications in harmonic analysis and number theory. Recently, Bourgain and Demeter obtained the decouplings for hypersurfaces with nonzero Gaussian curvature and the cone. However, little is known about the decouplings for surfaces with codimension larger than one. In this talk, we discuss the decouplings for d-dimensional surfaces in $\mathbb{R}^{2d}$, which generalize the result of Bourgain and Demeter. Especially, I give a proof of the decoupling for 3-dimensional surfaces in $\mathbb{R}^6$.

Polynomial Carleson operators along monomial curves in the plane

Joris Roos

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We prove partial L^p bounds for a polynomial Carleson operator along monomial curves (t, t^m) in the plane with a phase polynomial consisting of a single monomial. These bounds are partial in the sense that we only consider linearizing functions depending on one variable. Moreover, we can only deal with certain combinations of curves and phases. For some of these cases we use a vector-valued variant of the Carleson-Hunt theorem as a black box. As an ingredient of the proofs we use refined variants of Stein and Wainger's method for phases consisting of one and two fractional monomials. This is joint work with Shaoming Guo, Lillian Pierce and Po-Lam Yung.

The Fefferman-Stein type inequality for the directional maximal operator

Hiroki Saito

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Let $\mathfrak{M}_\Sigma f$ denote the directional maximal operator of f on $\mathbb{R}^2$, which is defined by the maximal average of f with respect to 2-dimensional rectangles with longest side is parallel to some unit vector in $\Sigma \subset S^1$. In this talk, we establish the Fefferman-Stein type inequality for $\mathfrak{M}_\Sigma$ and *any* weight w on $\mathbb{R}^2$: Let Σ_N be the set of uniformly spread directions with cardinality $N > 10$. Then

$$\sup_{t>0} t\, w(\{x \in \mathbb{R}^2 : \mathfrak{M}_{\Sigma_N} f(x) > t\})^{1/2} \le C(\log N)^{1/2} \|f\|_{L^2(\mathbb{R}^2, W)},$$

where $W(x) := \mathfrak{M}_{\Sigma_N} \mathcal{M} w(x)$, and $\mathcal{M}$ denotes the usual Hardy-Littlewood maximal operator. This result is valid for the strong maximal operator with a simple modification.

Complex interpolation of Morrey spaces

Yoshihiro Sawano

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There are two complex interpolations for Morrey spaces, both of which are defined by Calderón in 1964. Since the outputs of these two complex interpolations for Lebesgue spaces are the same, many people do not take into account seriously one of them. However, the outputs for Morrey spaces are different. In this talk, we are mainly concerned with the smoothness Morrey subspaces and will present the results for the first and second interpolation functors. This is a joint work with Denny Ivanal Hakim and Shohei Nakamura.

Improved Strichartz estimates in weighted L^2 spaces and their applications

Ihyeok Seo

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We improve some known weighted refinements of the classical Strichartz estimates. As consequences, we give an affirmative answer to an open question concerning a weighted L^2 Strichartz estimate for the Schrödinger equation, and we improve previously known Morawetz estimates. We also apply these estimates to the well-posedness theory for a class of dispersive equations. This is a joint work with Youngwoo Koh.

L^p boundedness of higher order Schrödinger type operators

Satoko Sugano

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Let $V(x)$ be a nonnegative potential and consider the Schrödinger type operators $H_k = (-\Delta)^k + V^k$ on $\mathbf{R}^n$, where k is a positive integer and $n \geq 2k+1$. We assume that the potential belongs to the reverse Hölder class which includes nonnegative polynomials. In this talk, I will show L^p boundedness of some operators concerning with H_k.

A criterion for the global boundedness of locally bounded integral operators

Mitsuru Sugimoto

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Let $\mathcal{P}$ be an integral operator of the form

$$\mathcal{P}u(x) = \int_{\mathbb{R}^n} K(x, y, x-y)u(y)\,dy.$$

We will discuss when the local boundedness of $\mathcal{P}$ implies the global one.

We introduce a notion of the uniform local boundedness of $\mathcal{P}$. By χ_K we denote the multiplication by the characteristic function of the set $K \subset \mathbb{R}^n$. H^1 denotes the Hardy space introduced by Fefferman-Stein. We say that the operator $\mathcal{P}$ is uniformly H^1_{comp}-L^1_{loc}-bounded if $\chi_{K_h}\mathcal{P}\chi_{K_h}$ is H^1-L^1-bounded uniformly in $h \in \mathbb{R}^n$ for the translated set $K_h = \{x+h : x \in K\}$ of any compact set $K \subset \mathbb{R}^n$.

Let $H(x, y, z)$ be the defining function of the singular support of $K(x, y, z)$:

$$\operatorname{sing\,supp} K(x, y, z) = (\mathrm{x,y,z}) : \mathrm{H}(\mathrm{x,y,z})=0,$$

and let

$$\widetilde{H}(z) = \inf_{x,y \in \mathbb{R}^n} H(x, y, z).$$

We assume the following three conditions:

(A1) There exist $\varepsilon > 0$ and $d > 0$ such that

$$\sup_{H(x,y,z)\geq d} \left|H(x,y,z)^{n+\varepsilon} K(x,y,z)\right| < \infty.$$

(A2) There exist $N > 0$ and $C > 0$ such that

$$|z| \geq N \quad \Rightarrow \quad \widetilde{H}(z) \geq C|z|.$$

(A3) $\quad \widetilde{H}(z) \geq 2|z'| \quad \Rightarrow \quad \widetilde{H}(z) \leq 2\widetilde{H}(z - z').$

Main Theorem Assume (A1) – (A3). Suppose that $\mathcal{P}$ is L^2-bounded and uniformly H^1_{comp}-L^1_{loc}-bounded. Then $\mathcal{P}$ is H^1-L^1-bounded.

As an application, we will also discuss the global boundedness of Fourier integral operators of a certain class.

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

The n linear embedding theorem

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Let σ_i, $i = 1, \ldots, n$, denote positive Borel measures on $\mathbb{R}^d$, let $\mathcal{D}$ denote the usual collection of dyadic cubes in $\mathbb{R}^d$ and let $K : \mathcal{D} \to [0, \infty)$ be a map. In this paper we give a characterization of the n linear embedding theorem.

That is, we give a characterization of the inequality

$$\sum_{Q\in\mathcal{D}} K(Q) \prod_{i=1}^{n} \left| \int_Q f_i \, d\sigma_i \right| \leq C \prod_{i=1}^{n} \|f_i\|_{L^{p_i}(d\sigma_i)}$$

in terms of the multilinear Sawyer testing conditions and the n weight discrete Wolff potential conditions, when $1 < p_i < \infty$.

The radial Glassey conjecture with minimal regularity

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In this talk, I will report our recent advances on the radial Glassey conjecture with minimal regularity assumption. More precisely, for semilinear wave equations of type $\Box u = |\partial_t u|^p$ with $p_c = 1 + 2/(n-1) < p < 1 + 2/(n-2)$, we prove the global existence for small data in H^s with $s > s_c = n/2 + 1 - 1/(p-1)$. It is known that $p > p_c$ is necessary for the problem to admit global solutions and $s \geq s_c$ is necessary for the problem to be local well-posed in H^s.

In the process, we exploit and prove a weighted fractional chain rule. We also show well-posedness for 3-D quadratic semi-linear wave equations with radial data in the almost scale-critical Sobolev space, which improves the earlier result of Klainerman and Machedon.

This is based on the joint work with Kunio Hidano, Jin-Cheng Jiang, Sanghyuk Lee.

The defocusing energy-supercritical nonlinear wave equation when $d = 4$

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In this talk, we consider the quintic defocusing nonlinear wave equation in dimension $d = 4$. This equation is $\dot{H}^{\frac{3}{2}}$ critical with respect to scaling, hence is energy supercritical. We proved that all solutions with a priori control on the critical norm must exsit globally and scatter. With some modification, the technique in this paper can also handle the equations with general energy supercirtical nonlinearities. Previous results on the same topic by Kenig & Merle and Killip & Visan, need either the dimension to be odd, or the data to be spherically symmetric. This is the first result that can deal with problem with general data in dimension 4 where the "strong Huygens" principle is not available and at the same time, the linear flow does not decay sufficiently fast. This work is jointed with Miao Changxing and Zhang xiaoyi.

On the boundedness of bi-parameter Littlewood-Paley operators

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In this talk, we will first recall the background of linear and bilinear Littlewood-Paley operators. Then, the rest of the talk will be devoted to present some recent results on the bi-parameter Littlewood-Paley operators,including Littlewood-Paley g-function and g_λ^* function. It is worth pointing out that the kernels are assumed to satisfy some estimates, including a natural size condition, a Hlder estimate and two symmetric mixed Hlder and size estimates, the mixed Carleson and size conditions, the mixed Carleson and Hlder estimates and a bi-parameter Carleson condition. Moreover, it should be noted that the bi-parameter Carleson condition is necessary for the square function to be bounded on L^2. Moreover,we don't need to assume that the kernel satifies the cancellation condition.

Multicommutators And Multiplier Theorems

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We obtain Lp-boundedness of the nth dimensional Calderon-Coifman-Journe type multicommutator. The proof exploits the limited smoothness of the symbol of the multicommutator via a new multilinear multiplier theorem for symbols of restricted smoothness which lie locally in certain Sobolev spaces. Our multiplier approach to this problem is a new contribution in the understanding of Calderon's commutator program. This is a joint work with Loukas Grafakos, Danqing He and Hanh Van Nguyen.

Average along holomorphic curves

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Averaging operators carry certain types of improving properties and investigating optimal improving properties of averaging operators is one of the main issues in harmonic analysis. The maximal amount of integrability and differentiability of functions which are bettered by averaging operators has been known to depend on the geometry of surfaces along which the integration is performed for the operators to be defined.
Let $z = x + iy \in \mathbb{C}$ and let $\gamma(z) = u(z) + iv(z)$ be a holomorphic function in an open set $\Omega \subset \mathbb{C}$. We consider a holomorphic curve Γ in $\mathbb{C}^2 = \mathbb{R}^4$ of the form

$$\Gamma(z) = (z, \gamma(z)),$$

which is a graph of the holomorphic function γ. We consider averaging operators $\mathcal{R}$ along the holomorphic curve Γ defined by

$$\mathcal{R}f(w) = \int_{\mathbb{C}} f(w - \Gamma(z))\chi(z)dz,$$

where $w = (w_0, w_1) \in \mathbb{C}^2$, χ is a smooth cut-off function supported in a bounded neighborhood U of the origin, and $dz = dx\,dy$.
In this talk we discuss on sharp L^p Sobolev estimates for averaging operators $\mathcal{R}$ along holomorphic curves Γ in $\mathbb{C}^2$. This is a joint work with Yaryong Heo(Korea University) and Sunggeum Hong(Chosun University).

Hardy-Trudinger-Moser and Hardy-Adams inequalities on hyperbolic spaces

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We give a rearrangement-free argument for a Hardy-Trudinger-Moser inequality on the hyperbolic space. The main idea is to adapt the level set developed by Lam and Guozhen Lu to derive a global Trudinger-Moser inequality from a local one. Furthermore, using this Hardy-Trudinger-Moser inequality, we obtain a Hardy-Trudinger-Moser inequality on any bounded and convex planar domain via the Riemann mapping theorem, which confirm a conjecture given by Guofang Wang and Dong Ye. We also give a Hardy-Adams inequality on hyperbolic space of dimension 4 and, as application, obtain a Hardy-Adams inequality on unit ball of Euclidean space of dimension 4. These results are jointed with Professor Guozhen Lu.

Linear damping in the inviscid flow

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Landau damping can be defined as damping of a collective mode of oscillations in a collisionless plasma. Analogues of Landau damping has been observed in the sheared hydrodynamic flows and MHD waves. In this talk, I will report our recent results on the damping of the linearized 2-D Euler equations around a monotone shear flow and the decay of Alfven waves in an inhomogeneous magnetic field.

New Abstract H^p spaces

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In this paper, we define the new abstract H^p spaces, and then prove some results about continuity on our Hardy spaces Hp and some bilinear theory. This is joint work with Liu Yin.