

Doctorial Forum of Mathematics between Fudan and Kyoto Universities

Time : November 1st, 2010 –November 5th, 2010
Opening Ceremony: 9:40 A.M.,Room 103, East Wing of Guanghai Building. School of Mathematical Sciences, Fudan University
Daily Place Room 1415, Guanghai East Main Building. School of Mathematical Sciences, Fudan University

Invited speakers

Meng Chen	Fudan University
Kunyu Guo	Fudan University
Jiaying Hong	Fudan University
Tsuyoshi Kato	Kyoto University
Wei Lin	Fudan University
Masaki Tsukamoto	Kyoto University
Yoshio Tsutsumi	Kyoto University
Jiangang Ying	Fudan University
Kenichi Yoshikawa	Kyoto University
James J. Zhang	Fudan University and University of Washington

	Programme				
	Nov.1st (Mon.)	Nov.2nd (Tue.)	Nov.3rd (Wed.)	Nov.4th (Thu.)	Nov.5th (Fri.)
9:00–10:00	Tsuyoshi Kato (10:00-11:00)	Jiaying Hong	Kenichi Yoshikawa	Masaki Tsukamoto	Meng Chen
10:30–11:30	James J. Zhang (11:10-12:10)	Yoshio Tsutsumi	Kunyu Guo	Wei Lin	Jiangang Ying
13:30–14:00	Tomohiro Fukaya	Kentaro Mitsui		Tomoko Takemura	Ryokichi Tanaka
14:00–14:30	Yan Wu	Liyu Liu		Daisuke Shiraishi	Nan Chen
14:30–15:00	Yosuke Imagi	Tatsuya Ohshita		Ke Wang	Shohei Honda
15:30–16:00	Zhijie Wang	Shengqiang Wang		Masaya Maeda	Kai Du
16:00–16:30	Kenta Okazaki	Yuji Odaka		Ning'an Lai	Mitsunobu Tsutaya
16:30–17:00	Xin Huang	Wei Han		Kaname Matsue	Can Zhu
17:00–17:30		Qi Ding		Peng Qu	

Sponsored by:
 Graduate School, Fudan University
 School of Mathematical Sciences, Fudan University
 Organized by:
 Student Union, School of Mathematical Sciences, Fudan University

Doctorial Forum of Mathematics between Fudan and Kyoto Universities

Nov. 1st (Mon.)

A.M.

Chair : Professor Quanshui Wu

- 8:30-9:40 Openning Ceremony for assignment and so on. Details will be discussed.
- 9:40-10:00 Openning Ceremony for speech, photos and so on. Details will be discussed.
- 10:00-11:00 Tsuyoshi Kato (Kyoto University)
Growth of Casson handles and complexity of smooth structure on 4-manifolds
- 11:00-11:10 Tea break
- 11:10-12:10 James J. Zhang (Fudan University and University of Washington)
Recent developments in non-commutative algebraic geometry
- 12:00-13:30 Lunch

P.M.

Chair : Shohei Honda and Peng Qu

- 13:30-14:00 Tomohiro Fukaya (Kyoto University)
Coarse geometry and topology of Higson corona
- 14:00-14:30 Yan Wu (Fudan University)
Finite decomposition complexity of Thompson group
- 14:30-15:00 Yosuke Imagi (Kyoto University)
Action functionals in calibrated geometry
- 15:00-15:30 Tea break
- 15:30-16:00 Zhijie Wang (Fudan University)
Reducing subspaces of the weighted Bergman space
- 16:00-16:30 Kenta Okazaki (RIMS)
On the spin refined Reshetikhin-Turaev $SU(2)$ invariants of lens spaces
- 16:30-17:00 Xin Huang (Fudan University)
Solving low-rank damping nonlinear eigenvalue problems

Doctorial Forum of Mathematics between Fudan and Kyoto Universities

Nov. 2nd (Tue.)

A.M.

Chair Person: Professor Tsuyoshi Kato

- 9:00-10:00 Jiaxing Hong (Fudan University)
Global smooth solutions to Dirichlet problem for degenerate elliptic Monge-Ampere equations
- 10:00-10:30 Tea break
- 10:30-11:30 Yoshio Tsutsumi (Kyoto University)
Stability of cavity soliton for the Lugiato-Lefever equation
- 11:30-13:30 Lunch

P.M.

Chair : Tomohiro Fukaya and Yan Wu

- 13:30-14:00 Kentaro Mitsui (Kyoto University)
Multiple fibers of type $\$_mL_0\$$
- 14:00-14:30 Liyu Liu (Fudan University)
The Gorenstein property of Podle's quantum 2-spheres
- 14:30-15:00 Tatsuya Ohshita (Kyoto University)
On the higher Fitting ideals of Iwasawa modules over real abelian fields
- 15:00-15:30 Tea break
- 15:30-16:00 Shengqiang Wang (Fudan University)
Artin-Schelter-regular algebras of dimension 5
- 16:00-16:30 Yuji Odaka (RIMS)
On the GIT stability of polarized varieties
- 16:30-17:00 Wei Han (Fudan University)
Blow up of solutions to semilinear wave equations with variable coefficients and boundary
- 17:00-17:30 Qi Ding (Fudan University)
The inverse mean curvature flow in rotationally symmetric spaces

Doctorial Forum of Mathematics between Fudan and Kyoto Universities

Nov. 3rd (Wed.)

A.M.

Chair : Professor Yoshio Tsutsumi

- 9:00-10:00 Kenichi Yoshikawa (Kyoto University)
The conjecture of Bershadsky-Cecotti-Ooguri-Vafa and Borchers products
- 10:00-10:30 Tea break
- 10:30-11:30 Kunyu Guo (Fudan University)
Multiplication operators on the Bergman space --- the connection between operator theory and von Neumann algebras
- 11:30-13:00 Lunch
- 13:00 Excursion

Nov. 4th (Thu.)

A.M.

Chair : Professor Kenichi Yoshikawa

- 9:00-10:00 Masaki Tsukamoto (Kyoto University)
On Bertelson-Gromov's dynamical Morse inequality
- 10:00-10:30 Tea break
- 10:30-11:30 Wei Lin (Fudan University)
Adaptive identification of parameters and delays in dynamical models
- 11:30-13:30 Lunch

P.M.

Chair : Ryokichi Tanaka and Nan Chen

- 13:30-14:00 Tomoko Takemura (Nara Women's University)
Time changed skew product diffusions and their limit theorem
- 14:00-14:30 Daisuke Shiraishi (Kyoto University)
Random walk on random walk trace
- 14:30-15:00 Ke Wang (Fudan University)
Global exact boundary controllability for 1-D quasilinear wave equations
- 15:00-15:30 Tea break
- 15:30-16:00 Masaya Maeda (Kyoto University)
Stabilization of ground states of NLS with fourth order dispersion
- 16:00-16:30 Ning'an Lai (Fudan University)
Potential well and exact boundary controllability for the semilinear wave equations
- 16:30-17:00 Kaname Matsue (Kyoto University)
Dynamical method to rigorous verification of equilibria for evolutionary equations
- 17:00-17:30 Peng Qu (Fudan University)
ODE singularity for blocked linearly degenerate quasilinear hyperbolic systems

Doctorial Forum of Mathematics between Fudan and Kyoto Universities

Nov. 5th (Fri.)

A.M.

Chair : Professor Masaki Tsukamoto

- 9:00-10:00 Meng Chen (Fudan University)
On explicit birational geometry of algebraic 3-folds
- 10:00-10:30 Tea break
- 10:30-11:30 Jiangang Ying (Fudan University)
Transforms of symmetric Markov processes
- 11:30-13:30 Lunch

P.M.

Chair : Kentaro Mitsui and Shengqiang Wang

- 13:30-14:00 Ryokichi Tanaka (Kyoto University)
Nonlinear diffusion limits for exclusion processes in crystal lattices
- 14:00-14:30 Nan Chen (Fudan University)
Asymptotic analysis of the differences between the Stokes-Darcy system with different interface conditions and the Stokes-Brinkman system
- 14:30-15:00 Shohei Honda (RIMS)
Ricci curvature and convergence of Lipschitz functions
- 15:00-15:30 Tea break
- 15:30-16:00 Kai Du (Fudan University)
Degenerate backward stochastic PDEs and their applications
- 16:00-16:30 Mitsunobu Tsutaya (Kyoto University)
Finiteness of A_n -equivalence types of gauge groups
- 16:30-17:00 Can Zhu (Fudan University)
Poincaré-Birkhoff-Witt-deformation of higher Calabi-Yau algebras

Growth of Casson handles and complexity of smooth structure on 4-manifolds

Tsuyoshi Kato

In this talk, I will survey how to analyze complexity of smooth structure on 4-manifolds, by a functional analytic method. Complexity can be measured by growth of the associated signed infinite trees.

Recent developments in non-commutative algebraic geometry

James J. Zhang

In this talk, I will talk about some recent results in non-commutative algebraic geometry.

Coarse geometry and topology of Higson corona

Tomohiro Fukaya

Higson corona is a boundary of metric space, which contains information of asymptotic behavior of the metric space. Weinberger conjecture relate topology of Higson corona to the Novikov conjecture. I will explain a fixed point theorem on Higson corona and splitting theorem of a sublinear Higson corona, which is a variant of Higson corona.

Finite decomposition complexity of Thompson group

Yan Wu

The notion of finite decomposition complexity was recently introduced in metric geometry to study the coarse Novikov conjecture and the stable Borel conjecture. In this paper we compute finite decomposition complexity of some subgroups of Thompson group F and show that F equipped with the word-metric with respect to the infinite generating set $\{x_0, x_1, \dots, x_n, \dots\}$ does not have finite decomposition complexity.

Action functionals in calibrated geometry

Yosuke Imagi

Calibrated geometry is an area of differential geometry which studies a special class of volume-minimizing submanifolds, called calibrated submanifolds, in an Euclidean space or some Riemannian manifold.

This talk consists of two parts. In the first part, we define an action functional such that the trajectories of the gradient flow of the functional give calibrated submanifolds. In the other part, we discuss a family of calibrated submanifolds converging to a calibrated annulus, using another action functional.

Reducing subspaces of the weighted Bergman space

Zhijie Wang

In this paper, we mainly prove that the analytic Toeplitz operator with finite Blaschke product symbol on the weighted Bergman Spaces has at least a reducing subspace on which the restriction of the associated Toeplitz operator is unitary equivalent to the weighted Bergman shift.

On the spin refined Reshetikhin-Turaev $SU(2)$ invariants of lens spaces

Kenta Okazaki

In 1991, Reshetikhin and Turaev defined the quantum $SU(2)$ invariants of closed oriented 3-manifolds, called the Reshetikhin-Turaev $SU(2)$ invariants.

At $4n$ -th (resp. $4n + 2$ -nd) roots of unity, there exists a series of invariants which refines the R-T $SU(2)$ invariants associated with spin structures (resp. first cohomology classes).

For lens spaces, the refined R-T $SU(2)$ invariants associated with first cohomology classes have been calculated.

In this talk, we calculate the spin refined R-T $SU(2)$ invariants of lens spaces. By using this result, we also calculate the spin refined Turaev-Viro invariants of lens spaces.

Solving Low-Rank Damping Nonlinear Eigenvalue Problems

Xin Huang

Nonlinear eigenvalue problem (NEP) is a class of eigenvalue problems where the matrix depends on the eigenvalue. In this talk, I will introduce the NEP with low-rank damping. For rank-one damping NEP, I will present the existence theory of the eigenvalues and the convergence analysis of the algorithms. I will also introduce a new algorithm for solving low-rank damping nonlinear eigenvalue problems.

Global smooth solutions to Dirichlet problem for degenerate elliptic Monge-Ampere equations

Jiaying Hong

Consider a kind of degenerate elliptic Monge-Ampere equations

$$\det(D^2u) = K(x)f(x, u, Du) \text{ in } \Omega \subset R^2 \text{ with } u = 0 \text{ on } \partial\Omega.$$

Suppose that $f \in C^\infty$ is positive and $\Omega \in C^\infty$, strictly convex and that $K = d^m \tilde{K}$ for some integer m and smooth positive function \tilde{K} where d is the defining function of $\partial\Omega$. Then we have

Theorem 0.1 *Any C^2 -solution to the above problem is in $C^\infty(\bar{\Omega})$. Moreover, if f satisfies some natural structure condition or there exists a C^2 -subsolution and $f_u(x, u, p)$ nonnegative, the above problem always admits a unique solution smooth up to the boundary.*

As an application

Theorem 0.2 *The eigenvalue problem*

$$\det(D^2u) = \lambda u^2 \text{ in } \Omega \subset R^2 \text{ with } u = 0 \text{ on } \partial\Omega$$

always has a solution (λ, u) where $u \in C^\infty(\bar{\Omega})$, $u < 0 \in \Omega$ and convex provided that Ω is smooth, strictly convex.

Our arguments consists of two main ingredients. One is to give a positive lower bound for Δu and another is to present a priori estimates for a class of linear degenerate elliptic problem which is very closely related to the above degenerate elliptic Monge-Ampere equations.

Stability of cavity soliton for the Lugiato-Lefever equation

Yoshio Tsutsumi

We consider the stability of stationary solution for the Lugiato-Lefever equation with periodic boundary condition, to which is referred as (LL). The (LL) equation is a nonlinear Schrödinger equation with damping and spatially homogeneous forcing terms, which describes a physical model of a unidirectional ring or Fabry-Perot cavity with plane mirrors containing a Kerr medium driven by a coherent plane-wave field. The stationary solution of (LL) is called a “Cavity Soliton”. I present results about the stability of stationary solution under deterministic and stochastic perturbations, which have recently been obtained in collaboration with T. Miyaji, RIMS and I. Ohnishi, Hiroshima University. My talk is organized as follows.

(i) Existence of linearly stable stationary solution

I first present a brief review about the existence of linearly stable stationary solution, which is proved by the bifurcation theory.

(ii) Perturbation of initial data

I show the Strichartz estimate of the linearized operator around the linearly stable stationary solution, which leads to the nonlinear stability of the stationary solution.

(iii) Perturbation of additive noise

I show the stability of the stationary solution under the perturbation of additive noise from a viewpoint of the Freidlin-Wentzell type large deviation principle.

Multiple fibers of type ${}_mI_0$

Kentaro Mitsui

I am interested in the algebraic (and analytic) surface theory and rigid analytic geometry. In my talk, we will present our study of algebraic (complex analytic, and rigid analytic) elliptic surfaces.

An elliptic surface is a surface fibered over a curve each of whose fibers is isomorphic to an elliptic curve except for finitely many degenerated fibers. First, we will review a classification of elliptic surfaces. In the classification, multiple fibers of these surfaces play an important role. Next, we will explain our study of multiple fibers in a local situation. More precisely, we study elliptic fibrations with a multiple fiber of type ${}_mI_0$ over a complete discrete valuation ring with an algebraically closed residue field. Here, the type means that the multiplicity is equal to m , and that the reduction of the fiber is isomorphic to an elliptic curve. Finally, we will apply our results to the classification of elliptic surfaces. We will also propose some problems about multiple fibers.

The obtained results may be summarized into five parts:

1. A method for resolution and construction of the multiple fibers.
2. A method for calculating their invariants.
3. Classification of their isomorphism classes.
4. Examples of previously unknown types of algebraic elliptic surfaces.
5. Classification of elliptic surfaces with $\chi = 0$ and $\kappa = 0$.

The Gorenstein property of Podleś quantum 2-spheres

Liyu Liu

Podleś introduced a class of quantum 2-spheres homogeneous under the quantum $SU(2)$ action. These spheres (spaces) are quantum analog of the classical homogenous spaces. Krämer proved that the standard Podleś quantum 2-sphere is AS-Gorenstein and he asked, does it hold for non-standard Podleś quantum 2-spheres?

This paper proves the following proposition.

Suppose that $X = \alpha EK^{-1} + \beta F + \gamma(K^{-1} - 1)$ is a skew primitive element in $\mathcal{U}_q(\mathfrak{sl}(2, k))$. When the parameters satisfy $\alpha - q\beta - (q - q^{-1})\gamma \neq 0$, then the Podleś quantum spheres determined by X are AS-Gorenstein, Auslander-Gorenstein and Cohen-Macaulay.

The dual case is also studied. We give a classification of the quantum homogeneous spaces of $\mathcal{U}_q(\mathfrak{sl}(2, k))$ and check the AS-Gorenstein, Auslander-Gorenstein and Cohen-Macaulay properties.

On the higher Fitting ideals of Iwasawa modules over real abelian fields

Tatsuya Ohshita

Masato Kurihara (Keio Univ.) determined the higher Fitting ideal of the “minus-part” of Iwasawa modules of ideal class groups over totally real fields. In this talk, we will talk about our result on the higher Fitting ideals of the “plus-part” of Iwasawa modules over abelian fields. On the plus-part, we have not determined the higher Fitting ideals, but constructed some ideals which give upper bounds of them. This result can be regarded as a refinement of the plus-part of Iwasawa main conjecture.

Artin-Schelter-regular algebras of dimension 5

Shengqiang Wang

We first review the special example of regular algebra given by G. Floystad and J. E. Vatne. We prove it is strongly Noetherian, Auslander-regular and Cohen-Macaulay. Then we give several families of Artin-Schelter-regular algebras of dimension 5. Under some “generic” conditions, this will be a complete list of Artin-Schelter-regular algebras of dimension 5 that are generated by two generators of degree 1 and have 3 relations of degree 4.

On the GIT stability of polarized varieties

Yuji Odaka

To form a moduli as algebraic varieties (or even as Hausdorff space) of mathematical objects, we should put restrictions on the objects. GIT stability is an algebro-geometric formulation of such restriction due to Mumford and that of (polarized) varieties are related to the problem of the existence of “canonical” Kähler metrics — differential geometric aspect.

The content of the talk will be about these issues, with certain focus on the work by the speaker, which makes some connection with the theory of singularities and moduli construction which is relatively recently developed along the log minimal model program (LMMP).

Blow up of solutions to semilinear wave equations with variable coefficients and boundary

Wei Han

This paper is devoted to studying initial-boundary value problems for semilinear wave equations and derivative semilinear wave equations with variable coefficients on exterior domain with subcritical exponents in n space dimensions. We will establish blowup results for the initial-boundary value problems. It is proved that there can be no global solutions no matter how small the initial data are, and also we give the lifespan estimate of solutions for the problems.

The inverse mean curvature flow in rotationally symmetric spaces

Qi Ding

In this paper, we study the motion of inverse mean curvature flow which starts from a closed star-shaped hypersurface in special rotationally symmetric spaces, we prove that the flow converges to a unique geodesic sphere, i.e. every principle curvature of the hypersurfaces converge to a same constant under the flow.

The conjecture of Bershadsky-Cecotti-Ooguri-Vafa and Borchers products

Kenichi Yoshikawa

Bershadsky-Cecotti-Ooguri-Vafa conjectured that the generating function of elliptic instanton numbers of a Calabi-Yau threefold coincides with the analytic torsion of its mirror family. We explain this conjecture and its relation with Borchers products. If time permits, we also explain some examples.

Multiplication operators on the Bergman space — the connection between operator theory and von Neumann algebras

Kunyu Guo

In this talk, we will combine methods of complex analysis, operator theory and conformal geometry to construct a class of type II factors in the theory of von Neumann algebras, which arise essentially from holomorphic coverings of bounded planar domains. One will see how types of such von Neumann algebras are related to conformal geometries of planar domains. An interplay of analytical, geometrical, operator and group theoretical techniques is intrinsic to this work. (jointly with Hansong Huang)

On Bertelson-Gromov's dynamical Morse inequality

Masaki Tsukamoto

Bertelson-Gromov proposed the study of “dynamical Morse inequality”. I will explain their ideas. If I have enough time, I will also explain some related topics based on the joint work with M. Asaoka, T. Fukaya and K. Mitsui.

Adaptive identification of parameters and delays in dynamical models

Wei Lin

In this talk, we present the recent progress in the adaptive identification of parameters and delays in dynamical models. Uniformly Lipschitz conditions in the existing literature are relaxed to the only locally Lipschitz conditions in our investigations. Numerical examples, as well as the real gene transcription system, are used to illustrate our theoretical results.

Time changed skew product diffusions and their limit theorem

Tomoko Takemura

Given two independent diffusions, we call the product of a diffusion process and a time changed diffusion process skew product diffusion. Where the time change is given by a positive continuous additive functional of first diffusion and some underlying measure. We are concerned with skew product diffusion processes of one dimensional diffusion processes and the spherical Brownian motion on S^{d-1} and their time changes which is given by a positive continuous additive functional with some underlying measure. We study convergence of a sequence of time changed skew product diffusion processes when a sequence of underlying measures converges to a degenerate one.

Random walk on random walk trace

Daisuke Shiraishi

Let S be a simple random walk starting at the origin in \mathbb{Z}^4 . We consider $\mathcal{G} = S[0, \infty)$ to be a random subgraph of the integer lattice and assume that a resistance of unit 1 is put on each edge of the graph \mathcal{G} . Let R_n be the effective resistance between the origin and S_n . We derive the exact value of the resistance exponent; more precisely, we prove that $n^{-1}E(R_n) \approx (\log n)^{-\frac{1}{2}}$. We also show that the chemical exponent is equal to the resistance exponent; namely, we prove that $n^{-1}E(d(0, S_n)) \approx (\log n)^{-\frac{1}{2}}$, where $d(\cdot, \cdot)$ is the graph distance on \mathcal{G} . Furthermore, we derive the precise exponent for the heat kernel and the mean-square displacement of a random walk on \mathcal{G} at the quenched level. These results give the answer to the problem raised by Burdzy and Lawler (1990) in four dimensions.

Global exact boundary controllability for 1-D quasilinear wave equations

Ke Wang

Based on the local exact boundary controllability for 1-D quasilinear wave equations, the global exact boundary controllability for 1-D quasilinear wave equations in a neighborhood of any connected set of constant equilibria is obtained by an extension method. Similar results are also given for a kind of general 1-D quasilinear hyperbolic equations.

Stabilization of ground states of NLS with fourth order dispersion

Masaya Maeda

We investigate the existence, uniqueness and stability of the ground states of nonlinear Schrödinger type equations with a small fourth order dispersion. Such equations appear in the higher order approximation of the propagation of laser beam in Kerr medium. We show that for the critical case, the ground state, which is unstable in the absence of the fourth order dispersion, becomes stable with arbitrary small fourth order term. To prove this, we show the uniqueness of the ground states when the fourth order dispersion term is sufficiently small and investigate the spectrum of linearized operator using perturbation methods and apply the general theory of Grillakis, Shatah and Strauss.

Potential well and exact boundary controllability for the semilinear wave equations

Ning'an Lai

In this paper, we consider the exact boundary controllability for the cubic focusing semilinear wave equations in $1 \leq n \leq 3$ space dimensions. When the initial data and the final data are in the so called potential well, we find that the sufficient condition for the global existence is also sufficient to ensure the exact boundary controllability of the problem. Moreover, in one space dimension, the control time can be that of the linear wave equation.

Dynamical method to rigorous verification of equilibria for evolutionary equations

Kaname Matsue

I show a rigorous numerical method for verifying the existence and the dynamical property of equilibria for dissipative evolutionary equations. In my approach, a topological tool called the Conley-Rybakowski index and the well-known numerical approximation method, the finite element method, are used. This method can be placed the starting point for understanding the global dynamics for dissipative evolutionary equations rigorously.

ODE singularity for blocked linearly degenerate quasilinear hyperbolic systems

Peng Qu

The mechanism of singularity formation is discussed for a kind of blocked quasilinear hyperbolic systems with linearly degenerate characteristics, so that the ODE singularity can be shown for some kinds of complete reducible systems and, in particular, all the results in [T.T. Li et al., *Math. Meth. App. Sci.*, 31 (2008), 193-227] can be proved without the original assumption on the part richness.

On explicit birational geometry of algebraic 3-folds

Meng Chen

We shall give a brief and elementary introduction to some new advances on explicit birational geometry of algebraic 3-folds.

Transforms of symmetric Markov processes

Jiangang Ying

This is a survey report on Dirichlet form characterization of transforms of symmetric Markov processes, such as killing transform, time change and drift transform

Nonlinear diffusion limits for exclusion processes in crystal lattices

Ryokichi Tanaka

We consider exclusion processes in crystal lattices which describe microscopic systems in statistical mechanics. We observe that nonlinear heat equation appear as macroscopic systems via scaling limits.

Asymptotic analysis of the differences between the Stokes-Darcy system with different interface conditions and the Stokes-Brinkman system

Nan Chen

We consider the coupling of the Stokes and Darcy systems with different choices for the interface conditions. We show that, comparing results with those for the Stokes-Brinkman equations, the solutions of Stokes-Darcy equations with the Beavers-Joseph interface condition in the one-dimensional and quasi-two-dimensional (periodic) cases are more accurate than are those obtained using the Beavers-Joseph-Saffman-Jones interface condition and that both of these are more accurate than solutions obtained using a zero tangential velocity interface condition. The zero tangential velocity interface condition is in turn more accurate than the free-slip interface boundary condition. We also prove that the summation of the quasi-two-dimensional solutions converge so that the conclusions are also valid for the two-dimensional case.

Ricci curvature and convergence of Lipschitz functions

Shohei Honda

Let $\{(M_i, m_i)\}_i$ be a sequence of pointed n -dimensional complete Riemannian manifolds with $\text{Ric}_{M_i} \geq -(n-1)$. Assume that the sequence $(M_i, m_i, \text{vol}/\text{vol}B_1(m_i))$ converges to a pointed metric measure space (M_∞, m_∞, v) in the sense of measured Gromov-Hausdorff topology. In this setting, Cheeger-Colding showed, there exists a cotangent bundle T^*M_∞ of M_∞ such that each fiber $T_x^*M_\infty$ of T^*M_∞ is a finite dimensional Hilbert space and that each locally Lipschitz function f on M_∞ has the canonical section $df(z) \in T_z^*M_\infty$ at a.e. $z \in M_\infty$. We remark that if M_∞ is a smooth Riemannian manifold, then this corresponds to the classical Rademachers theorem for differentiability of Lipschitz functions.

Let R be a positive number and f_i a Lipschitz function on $B_R(m_i)$ with $\sup \mathbf{Lip} f_i < \infty$, assume that f_i converges to f_∞ . Here $\mathbf{Lip} f$ is the Lipschitz constant of f . A goal in this talk is to give a definition: df_i converges to df_∞ at $x_\infty \in B_R(m_\infty)$. It is the following:

Definition 0.1

We say that df_i converges to df_∞ at $x_\infty \in B_R(m_\infty)$ if for every $\epsilon > 0$, $z_\infty \in M_\infty$, $x_i \in B_R(m_i)$ and $z_i \in M_i$ satisfying that x_i converges to x_∞ and that z_i converges to z_∞ , there exists $r > 0$ such that

$$\limsup_{i \rightarrow \infty} \left| \frac{1}{\text{vol}B_t(x_i)} \int_{B_t(x_i)} \langle dr_{z_i}, df_i \rangle d\text{vol} - \frac{1}{v(B_t(x_\infty))} \int_{B_t(x_\infty)} \langle dr_{z_\infty}, df_\infty \rangle dv \right| < \epsilon$$

and

$$\limsup_{i \rightarrow \infty} \frac{1}{\text{vol}B_t(x_i)} \int_{B_t(x_i)} |df_i|^2 d\text{vol} \leq \frac{1}{v(B_t(x_\infty))} \int_{B_t(x_\infty)} |df_\infty|^2 dv + \epsilon$$

for every $0 < t < r$. Here, r_z is the distance function from z , $\langle \cdot, \cdot \rangle$ is the inner product on each fiber of T^*M_∞ , $|\cdot|$ is the canonical norm.

In this talk, we will give several applications by using this notion, if time permits.

Finiteness of A_n -equivalence types of gauge groups

Mitsunobu Tsutaya

Stasheff considered A_n -maps, a generalization of H-maps between topological groups. Let G be a compact connected Lie group and B be a finite CW complex. Then the number of A_n -equivalence types of the gauge groups of principal G -bundles over B is finite.

Degenerate backward stochastic PDEs and their applications

Kai Du

In this talk we present the existence and uniqueness result for degenerate backward stochastic PDE, and introduce some applications in stochastic optimal control and the Feynmann-Kac representation.

Poincaré-Birkhoff-Witt-deformation of higher Calabi-Yau algebras

Can Zhu

The Calabi-Yau property of Poincaré-Birkhoff-Witt-deformation of a Koszul Calabi-Yau algebra is discussed, which generalizes Berger and Taillefer's results to Koszul Calabi-Yau algebras of higher dimensions. As a byproduct, we reobtain a necessary and sufficient condition of universal enveloping algebra, respectively, Sridharan enveloping algebra, of a finite-dimensional Lie algebra to be Calabi-Yau, which was proved by J.-W. He, Oystaeyen and Y. Zhang.