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Workshop on IDAQP and their Applications (3 - 7 March 2014)

Dedicated to Professor Takeyuki Hida

... Co-sponsored by RIST, Quantum Bio-informatics Research Division, Tokyo University of Science, Aichi Prefectural University

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Organizing Committee

Chair

- Masanori Ohya (Tokyo University of Science)

Members

- Louis Chen (National University of Singapore)
- Si Si (Aichi Prefectural University)
- Noboru Watanabe (Tokyo University of Science)

Advisory Committee

- Takeyuki Hida (Nagoya University and Meijo University)
- Luigi Accardi (University of Rome Tor Vergata)

Visitors and Participants

- Overseas visitors
- Local visitors
- Graduate students
- Registered local participants

Overview

In the past few years the fields of infinite dimensional analysis and quantum probability have undergone increasingly significant developments and have found many new applications, in particular, to classical probability and to different branches of physics. Those fields are rather wide and strongly related in interdisciplinary nature. We like to make a bridge among these interdisciplinary fields in our workshop. In these fields, we mainly focused on quantum information theory and white noise analysis in line with IDAQP. It is therefore quite a suitable time to organize an international workshop to have discussions among the researchers in the Asian area. We aim, through this workshop, at encouraging young mathematicians in Asian countries. We should consider good cooperation with researchers in other fields in order to

explore new research directions. They are cordially invited to study with us such new exciting areas in mathematical sciences as quantum information theory and white noise analysis.

Research Activity

(1) Quantum Information Theory:

Based on classical probability theory, Shannon found that the entropy, introduced by Clausius and Boltzmann, can be used to express the amount of information, and he proposed the so-called information communication theory at the middle part of the 20th century. In his information theory, the entropy and the mutual entropy (information) are most important concepts and it has valuable contribution to modern society.

Since the present optical communication is using the optical signal including quantum effect, it is necessary to construct new information theory dealing with those quantum phenomena in order to discuss the efficiency of information transmission of optical communication processes rigorously. The quantum information theory is important in both mathematics and engineering, and it contains several topics, for instance, quantum entropy theory, quantum communication theory, quantum teleportation, quantum entanglement, quantum algorithm, quantum coding theory and so on. It has been developed with quantum entropy theory and quantum probability. In quantum information theory, one of the important problems is to investigate how much information is exactly transmitted to the output system from the input system through a quantum channel. The amount of information of the quantum communication system is described by the quantum mutual entropy defined by Ohya [O1], based on the quantum entropy by von Neumann, and the quantum relative entropy by Umegaki and Araki. The quantum information theory directly relates to quantum communication theory, for instance, [W1]. One of the most important communication processes is quantum teleportation, whose new treatment was studied in [O5]. It is important to classify quantum states. One of such classifications is to study entanglement and separability of states. There have been lots of trials in finite dimensional Hilbert spaces. Quantum mechanics should be basically discussed in infinite dimensional Hilbert spaces. We have to study such a classification in infinite dimensional Hilbert spaces.

It is possible to improve the performance of computers by using quantum effects. The quantum computer is highly anticipated giving a remarkable development for several research fields of the 21st century. Shor showed the effectiveness of the quantum computer in the prime factorization problem. Ohya and Volovich [O4] considered the NP-complete problems, which are more difficult than the prime factorization problem, based on usual quantum algorithm and classical amplification by logistic map. They (OV) have shown that the satisfiability (SAT) problem as a NP-complete problem can be mathematically solved in polynomial time by using their new quantum algorithm (see their book [B2] published from Springer-Verlag, page 369-395). Their algorithm is a mathematical precise construction solving NP-complete problems in quantum region.

Recently, one faces a fundamental problem appearing in many experiments (see [5-10]), particularly in biology, psychology and so on. It is the breaking of total probability law. We have studied this problem and we found a

mathematical treatment [4] solving this problem in terms of the concepts of liftings [O3] and adaptive dynamics [O6]. This new mathematics is one of the non-Kolmogorovian probability theory. We have lots of rooms to develop the theory.

(2) White Noise Analysis:

The dawning of the age of modern stochastic analysis is now with us. White noise analysis would be in a leading position of the analysis, and now it must be a good time to contribute to the development of the new exciting directions.

To concretize the idea and to be more precise from the white noise side, we propose two significant directions to be accomplished with much hope.

(i) Discover some more characteristic properties of generalized white noise functionals. There follows naturally the efficient use of the calculus to solve many problems in applications. We have so far obtained good results in quantum dynamics, path integrals and biology.

What we have really in mind in this direction are more general theory. Namely, we aim at discovering good realizations of "Duality", "Invariance", "Optimality" and other properties. As for the invariance, we have employed the "infinite dimensional rotation group " under which the white noise measure is kept invariant. Finer structure of the group should be investigated more extensively.

We have recognized that the notion of duality plays very significant role in the study of the analysis of white noise functionals. We have, so far, discovered only a little. In search of good examples we have to appeal to various tools from abstract mathematics.

As for the optimality we are suggested to consult with other fields like quantum information, molecular biology and statistics.

(ii) The second direction is concerned with the problem "Passage from digital to analogue". Namely, it means the passage from a system with discrete parameter to that is parametrized by a continuous parameter.

Unlike the case where non-random functions are concerned, the limiting procedure of random functions is very much complicated, so that careful considerations should be involved.

This problem itself is concerned with the foundation of probability theory. In order to investigate random complex phenomena, we are recommended to come to a system of independent elemental random variables, simply called "noise". The noise from which random variables are formed is parameterized, usually either by discrete parameter or continuous case.

In any case, functionals formed by discrete parameter noise lead us somewhat easy calculus, but they do approximate the functionals of a continuous parameter noise, which is to be taken mostly care of and is definitely important.

The case where functionals of Gaussian noise or Poisson noise depending on continuous time has been studied to some extent. For instance, nonlinear functionals of continuous parameter noise usually require renormalization. The

operators used to analyze those functionals need careful modifications of those for discrete case, although we can give expressions of the operators analogous to those in the discrete parameter case.

After these complicated interpretations, appear real problems. There is a new noise depending on the space parameter. The significance of that noise has just been recognized recently. The probabilistic properties are, of course, different from those depending on time parameter and most of the properties of functionals of this new noise are not known. Still we know that lots of applications of analysis of functionals of new noise are not well discussed. It is interesting and important in applications to investigate of the functionals of new noise, where approximation is necessary. We shall find significant dissimilarity between time and space noises, in particular in the approximation course of digital to analogue. Thus, we have been given more complex and difficult problems in the analysis of generalized functionals of a noise depending on space.

Activities

Monday, 3 Mar 2014	
09:45am - 10:00am	Registration
10:00am - 10:10am	Opening Remarks *Louis Chen, National University of Singapore*
10:10am - 11:00am	Some of future directions of white noise theory *Takeyuki Hida, Nagoya University and Meijo University, Japan*
11:00am - 11:20am	*--- Group Photo & Coffee Break ---*
11:20am - 12:10pm	A mathematical realization of von Neumann's measurement scheme *Masanori Ohya, Tokyo University of Science, Japan*
12.10pm - 01:30pm	*--- Lunch Reception at IMS ---*
01:30pm - 02:20pm	On fluctuation with memory and white noise analysis *Christopher Casenas Bernido, Central Visayan Institute Foundation, Philippines*
02:20pm - 03:10pm	Local statistics for random self adjoint operators *Maddaly Krishna, The Institute of Mathematical Sciences, India*
03:10pm - 03:30pm	*--- Coffee Break ---*
03:30pm - 04:20pm	Quantum white noise derivatives and series expansions of super operators *Un Cig Ji, Chungbuk National University, Korea*
04:20pm - 05:10pm	Two types of quantum correlation of quantum composite system *Takashi Matsuoka, Suwa Science University, Japan*
Tuesday, 4 Mar 2014	
09:45am - 10:00am	Registration

10:00am - 10:50am	Quantum compressed sensing *Yazhen Wang, University of Wisconsin-Madison, USA*
10:50am - 11:10am	*--- Coffee Break ---*
11:10am - 12:00nn	Normal approximation for Jack measures *Louis Chen, National University of Singapore*
12.00nn - 01:30pm	*--- Lunch ---*
01:30pm - 02:20pm	Quantum quadratic operators and their properties *Farrukh Mukhamedov, International Isalamic University, Malaysia*
02:20pm - 03:10pm	Multiple Markov properties of Gaussian processes and their control *Win Win Htay, Yangon Technological University, Myanmar*
03:10pm - 03:30pm	*--- Coffee Break ---*
03:30pm - 04:20pm	Stochastic integration with respect to Gaussian processes *Joachim Lebovits, University of Heidelberg, Germany*
04:20pm - 05:10pm	New noise depending on the space parameter and the concept of multiplicity *Si Si, Aichi Prefectural University, Japan*
Wednesday, 5 Mar 2014	
09:45am - 10:00am	Registration
10:00am - 10:50am	Deduction of non--commutativity from commutativity: applications to quantum mechanics and classical probability theory *Luigi Accardi, University of Rome Tor Vergata, Italy*
10:50am - 11:10am	*--- Coffee Break ---*
11:10am - 12:00nn	Evolution with gross Laplacian noise *Kalyan B. Sinha, JN Centre for Advanced Scientific Research, India*
12.00nn - 01:30pm	*--- Lunch Reception at IMS ---*
01:30pm - 02:45pm	Free Discussion on IDAQP
03:00pm	Gardens by the Bay Excursion (Self- Paid) Address: 18 Marina Gardens Drive Singapore 018953
Thursday, 6 Mar 2014	
09:45am - 10:00am	Registration
10:00am - 10:50am	Quantum holography and classical random fields *Igor Volovich, Steklov Mathematical Institute, Russia*
10:50am - 11:10am	*--- Coffee Break ---*
11:10am - 12:00nn	Dynamic behavior of some stochastic predator-prey models *Huu Du Nguyen, Vietnam National University, Vietnam*

12.00nn - 01:30pm	*--- Lunch ---*
01:30pm - 02:20pm	Itô formula for generalized white noise functionals *Yuh-Jia Lee, National University of Kaohsiung, Taiwan*
02:20pm - 03:10pm	Hida distribution construction of indefinite metric $(Ø^p)_d$ ($d \geq 4$) quantum field theory *Minoru Yoshida, Tokyo City University, Japan*
03:10pm - 03:30pm	*--- Coffee Break ---*
03:30pm - 04:20pm	A hysteresis effect on optical illusion and non-Kolmogorovian probability *Yoshiharu Tanaka, Tokyo University of Science, Japan*
04:20pm - 05:10pm	Weighted Fourier algebras on SUq(2): characters and finite dimensional representations *Hun Hee Lee, Seoul National University, Korea*
Friday, 7 Mar 2014	
09:45am - 10:00am	Registration
10:00am - 10:50am	Polymer measures - a progress report *Ludwig Streit, University Bielefeld & Campus Universitario da Penteada, Germany*
10:50am - 11:10am	*--- Coffee Break ---*
11:10am - 12:00nn	Note on entropy type complexity of communication processes *Noboru Watanabe, Tokyo University of Science, Japan*
12.00nn - 01:30pm	*--- Lunch ---*
01:30pm - 02:20pm	Sensitive homology searching based on MTRAP alignment *Toshihide Hara, Tokyo University of Science, Japan*
02:20pm - 02:40pm	*--- Coffee Break ---*

Students and researchers who are interested in attending these activities are requested to complete the online registration form.

The following do not need to register:

- Those invited to participate.

Venue

- IMS Auditorium

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