The 4th Workshop on
Spectral Graph Theory and Related Topics[1]

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   Date : November 20 (Fri)–22 (Sun), 2015
Venue : University of Tsukuba
        Laboratory of Advanced Research B (Room 110)
        `http://www.tsukuba.ac.jp/access/gmap/gmap.php?i=106030`

Program

Friday, November 20

14:00–14:05   Opening address
             Tetsuji Taniguchi (Hiroshima Institute of Technology)

14:05–14:45   Sho Kubota (Tohoku University)
             Switched symplectic graphs obtained from the orbit partitions

14:55–15:35   Yuhei Inoue (Tohoku University)
             A new approach to the four color theorem and a number of 4-colorings of biwheels

15:45–16:25   Kiyoto Yoshino (Tohoku University)
             Embedding a weighted graph and contribution rate

16:35–18:00   **Free discussion**

Saturday, November 21

10:00–10:40 Takashi Komatsu (Tohoku University)
Limiting distributions of discrete-time quantum walks on the square lattice

10:50–12:20 [**Special talk**] Iwao Sato
(National Institute of Technology, Oyama College)
Zeta function of a graph and its applications

12:20–14:20 **Lunch**

14:20–15:00 Kazuhiro Kawamura (University of Tsukuba)
Laplacian eigenvalues of subdivision graphs of stars

15:10–15:50 Gary Greaves (Tohoku University)
On the clique number of strongly regular graphs

16:00–16:40 Masanori Sawa (Kobe University)
A bound for the inertia of Hermitian matrices and its applications to finite combinatorics

16:50–18:00 **Free discussion**

Sunday, November 22

10:00–10:40 Shohei Satake (Nagoya University)
Asymmetry of oriented graph

10:50–11:30 Yoichi Izunaga (University of Tsukuba)
A doubly non-negative relaxation for modularity density maximization

11:40–12:20 Hisashi Morioka (Shibaura Institute of Technology)
Complex Fermi surfaces and spectrum of discrete Laplacian on perturbed lattices

12:20–12:25 Closing address
Yoshio Sano (University of Tsukuba)

12:30–14:00 **Free discussion**

Abstract

Sho Kubota (Tohoku University)
Title : Switched symplectic graphs obtained from the orbit partitions
Abstract : For a partition of the vertex set of a graph, to apply the Godsil-McKay switching, it must satisfy two strong conditions. However every orbit partition of a group of automorphism satisfies one of them automatically. I found orbit partitions that satisfy the other condition and applied the Godsil-McKay switching. As a result I obtained three new families of strongly regular graphs. In this talk I will present one of these families.

Yuhei Inoue (Tohoku University)
Title : A new approach to the four color theorem and a number of 4-colorings of biwheels
Abstract : The four color theorem is known as a theorem whose proof is very long. There are many propositions and conjectures of Bowlin and Brin to get a shorter proof of the theorem using a group known as Thompson's F. One of their conjectures has been proved by Seymour, but we have found a mistake in the proof. We will introduce relations between the four color theorem and Thompson's F, and Seymour's mistake by exihibiting a counterexample.

Kiyoto Yoshino (Tohoku University)
Title : Embedding a weighted graph and contribution rate.
Abstract : It is one of the means to utilize data effectively to reduce the dimension of them. Therefore we want embedding data into a low-dimensional real coordinate space. A spectral approach realizes a embedding such as to maintain the structure. In fact, since we obtain a weighted graph from data, the Laplace matrix is defined and its eigenvectors corresponding to small eigenvalues without zero assign coordinates to each vertex. We introduce the contribution rate to improve the method.

Takashi Komatsu (Tohoku University)
Title : Limiting distributions of discrete-time quantum walks on the square lattice
Abstract : We investigate discrete-time quantum walks on the square lattice. The notion of quantum walks was introduced by Y. Aharonov et al. as a quantum counterpart of the classical random walks. Recently, quantum walks have been intensively studied in connection with quantum computing and quantum physics. In this talk, we propose a model of discrete-time quantum walks on the square lattice without localization and give its limit distribution. Furthermore, we see that the Konno function appears as the density function with respect to radial direction in our quantum walk and give another expression of our result from the view point of the quantum information.

[**Special talk**] Iwao Sato (National Institute of Technology, Oyama College)

Title : Zeta function of a graph and its applications

Abstract : We give a survey for the Ihara zeta function of a graph and its generalizations. Furthermore, we talk about applications of their determinant expressions to quantum walk etc.

Kazuhiro Kawamura (University of Tsukuba)

Title : This talk presents the results obtained in the Master Thesis: Masayuki Munakata, Laplacian eigenvalues of trees, submitted to Univ. Tsukuba, 2014. Let $S_{k,l}$ be the graph obtained from the star S_k of size $k+1$ with k pendants, by subdividing each edge of S_k with l vertices. Munakata determined the Laplacian eigenvalues of $S_{k,1}$. For $l \geq 2$, he made a conjecture on the behavior of the Laplacian eigenvalues when $k \to \infty$ with l fixed, and partially answered the conjecture. His result seem to exhibit a prototype which might be observed in a wider class of graphs. We present his result with a couple of background information and discuss some related problems.

Gary Greaves (Tohoku University)

Title : On the clique number of strongly regular graphs

Abstract : I will present a new upper bound on the clique number of a strongly regular graph in terms of its parameters. I will show that this bound is always at least as good as Delsarte's bound and better than Delsarte's bound for infinitely many strongly regular graphs. This talk is based on joint work with Leonard Soicher.

Masanori Sawa (Kobe University)

Title : A bound for the inertia of Hermitian matrices and its applications to finite combinatorics

Abstract : We give a lower bound on the inertia of Hermitian matrices and algebraic conditions for equality, designed as a generalization of some knwon inequalities such as Graham-Pollak inequality in graph theory and Fisher's inequality in combinatorial design theory.

Shohei Satake (Nagoya University)

Title : Asymmetry of oriented graph

Abstract : In this talk, we consider finite and countable oriented graphs. First,we define asymmetry number of finite oriented graph and show an upper bound. And we also introduce a result which shows that this bound is asymptotically best. Next,we show that coutable random oriented graph is almost surely isomorphic to a symmetric orented graph, namely RO, and we also show the cardninality of Aut(RO) and some graph theoretic results of RO.

Yoichi Izunaga (University of Tsukuba)

Title : A doubly non-negative relaxation for modularity density maximization

Abstract : Modularity proposed by Newman and Girvan is the most commonly used measure when the nodes of a graph are grouped into communities consisting of tightly connected nodes. However, some authors pointed out drawbacks of the modularity, the main issue of which is resolution limit. Resolution limit refers to the sensitivity of the modularity to the total number of edges in the graph, which leaves small communities not identified and hidden inside larger ones. To overcome this drawback, Li et al. have proposed a new measure called modularity density. In this talk, introducing a variant model of semidefinite programming (SDP) called 0-1SDP, we show that modularity density maximization can be modeled as 0-1SDP equivalently. Then we solve a relaxation problem of 0-1SDP in older to obtain an upper bound on the modularity density, and propose a lower bounding algorithm based on the combination of spectral heuristics and dynamic programming. This talk is based on joint work with Tomomi Matsui and Yoshitsugu Yamamoto.

Hisashi Morioka (Shibaura Institute of Technology)

Title : Complex Fermi surfaces and spectrum of discrete Laplacian on perturbed lattices

Abstract : We consider the Fermi surfaces of discrete Laplacian on perturbed lattices and its applications for a proof of absence of eigenvalues embedded in the continuous spectrum. This talk is based on joint works with Kazunori Ando and Hiroshi Isozaki.