The 34th PNU-PMI Algebraic Combinatorics Seminar

Organized by M.Hirasaka and J.Koolen

October 31, 2009

Place

C32-208, Department of Mathematics in Pusan National University

Program (October 31, 2009)

11:00–11:50, Akihiro Munemasa (Tohoku University)
Generalized Hadamard matrices

14:00–14:50, Tetsuji Taniguchi (Matsue College of Technology)
On a graph with the smallest eigenvalue at least $-\frac{1}{2}(3+\sqrt{5})$
— an irreducibility of Hoffman graphs —

15:00–15:50, Han Guk Kang (NIMS)
About symmetric matrixes whose diagonal elements are zero and off-diagonal elements are ± 1

16:10–17:00, Ebrahim Ghorbani (POSTECH and Sharif University of Technology)
A relation between the Laplacian and signless Laplacian eigenvalues of a graph

17:10–18:00, Toshifumi Tanaka (POSTECH)
Knot Floer homology and Alexander modules

18:30–20:30, Banquet

Available Devices for Presentation

We strongly encourage speakers to give a classical styled talk with chalk and blackboard. However, one beam projector is equipped at C32-208.

Speaker: Akihiro Munemasa (Tohoku University)

Title: Generalized Hadamard matrices

Abstract: The technique of elementary divisors can be applied to determine the rank of a Hadamard matrix modulo a prime. We extend this method to generalized Hadamard matrices over a cyclic group of order 3. In particular, identifying the cyclic group of order 3 with the multiplicative group of the finite field of GF(4) of four elements, we show that the rank of a generalized Hadamard matrix of order $n \equiv 2 \pmod 4$ over a cyclic group of order 3 is exactly $n/2$. This allowed us to classify such generalized Hadamard matrices of order 18 using the known classification of hermitian self-dual codes of length 18 over GF(4). This is based on a joint work with Masaaki Harada, Clement Lam and Vladimir Tonchev.

Speaker: Tetsuji Taniguchi (Matsue College of Technology)

Title: On a graph with the smallest eigenvalue at least $-\frac{1}{2}(3+\sqrt{5})$ — an irreducibility of Hoffman graphs —

Abstract: Hoffman graph may be regarded as a graph obtained by adding cliques to a simple graph, and is formally defined to be a graph which consists of the vertices of the simple graph and the fat vertices expressing the cliques. We may consider that the simple graphs are Hoffman graphs without fat vertices. In [3], R. Woo and A. Neumaier considered the "sum" of Hoffman graphs, but they did not formulate the concept of the "sum" since they treated it secondarily in order to consider another concept. By a process to study [4] and [5], we discovered the concepts of the "sum" and the "irreducible decomposition" of Hoffman graphs.

In this talk, we deal with an irreducibility of Hoffman graphs, and, in particular, Hoffman graphs with the smallest eigenvalue at least $-\frac{1}{2}(3+\sqrt{5})$.

References

[1] D. Cvetković, P. Rowlinson, S. K. Simić, Spectral Generalizations of Line Graphs – On Graphs with Least Eigenvalue -2, Cambridge Univ. Press, 2004.

[2] A. J. Hoffman, On graphs whose least eigenvalue exceeds $-1-\sqrt{2}$, Linear Algebra Appl. **16**:153–165 (1977).

[3] R. Woo and A. Neumaier, On graphs whose smallest eigenvalue is at least $-1-\sqrt{2}$, Linear Algebra Appl. **226–228**:577–591 (1995).

[4] T. Taniguchi, On graphs with the smallest eigenvalue at least $-1-\sqrt{2}$, part I, Ars. Math. Comtemp. **1**:81–98 (2008).

[5] T. Taniguchi, On graphs with the smallest eigenvalue at least $-1-\sqrt{2}$, part II, in preparation.

Speaker: Han Guk Kang (NIMS)

Title: About symmetric matrixes whose diagonal elements are zero and off-diagonal elements are ± 1

Abstract: Last month, Prof. Koolen suggested a problem related to a symmetric matrix with all zero diagonals and ± 1 off-diagonal elements. He conjectured that the minimum energy of all symmetric matrices with all zero diagonals and ± 1 off-diagonal elements might be $2(n-1)$. In this talk we will consider this problem.

Speaker: Ebrahim Ghorbani (POSTECH and Sharif University of Technology)

Title: A relation between the Laplacian and signless Laplacian eigenvalues of a graph

Abstract: This is a joint work with S. Akbari, J.H. Koolen, and M.R. Oboudi.

Let G be a graph of order n such that $\sum_{i=0}^{n}(-1)^i a_i \lambda^{n-i}$ and $\sum_{i=0}^{n}(-1)^i b_i \lambda^{n-i}$ are the characteristic polynomials of the signless Laplacian and the Laplacian matrices of G, respectively. We show that $a_i \geq b_i$ for $i = 0, 1, \ldots, n$, and the equalities hold for all $i = 0, 1, \ldots, n$ if and only if G is a bipartite graph. As a consequence, we proved that for every α, $0 < \alpha < 1$, if $q_1, \ldots, q_n$ and $\mu_1, \ldots, \mu_n$ are the signless Laplacian and the Laplacian eigenvalues of G, respectively, then $q_1^\alpha + \cdots + q_n^\alpha \geq \mu_1^\alpha + \cdots + \mu_n^\alpha$. Moreover, the equality is attained if and only if G is bipartite.

Speaker: Toshifumi Tanaka (POSTECH)

Title: Knot Floer homology and Alexander modules

Abstract: The Alexander module is a classical invariant of a knot, which is defined as the first integral homology group, as $\mathbb{Z}H_1(X)$-module, of the infinite cyclic covering space of the knot exterior X. In this talk, I shall give a pair of knots which have the same knot Floer homology and the same Khovanov homology, but different Alexander modules. This is a joint work with Jae Choon Cha.