



PC-Trees and Planar Graphs

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ABSTRACT

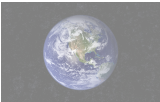
Linear time planarity test was first established by Hopcroft and Tarjan [1] in 1974 based on a path addition approach. A vertex addition approach, originally developed by Lempel, Even and Cederbaum, was later improved by Booth and Lueker [3] in 1976 to run in linear time using a data structure called “PQ-tree”. PQ-tree can also be used to test the consecutive ones property and to recognize interval graphs. In [4], Shih and Hsu developed a linear time planarity test based on PC-trees. PC-tree, a generalization of PQ-tree [5], is more natural in representing the relationships between biconnected components and nodes in planar graphs. Further exposition of Shih and Hsu algorithm can be found in Hsu and McConnell [6]. An earlier version [7] of Shih and Hsu [4] has been referred to as the simplest linear time planarity test by Thomas in his lecture notes [8]. In this talk we shall describe an ultimate version of planarity test based on PC-trees, which is much simpler than any previous version. Moreover, we shall describe how to extend this algorithm to find maximal planar subgraphs in linear time for arbitrary graphs.

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Ramsey Functions Involving Large Complete Graphs

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ABSTRACT

Let F and H be graphs. The Ramsey number $r(F, H)$ is defined as the minimum integer N such that any graph G of order N , either G contains F or \bar{G} contains H . We write $r(m, n) = r(K_m, K_n)$, which is called the classical Ramsey number.

From the definition, $r(F, K_n)$ is the minimum integer N such that any graph G of order N , either G contains F or $\alpha(G) \geq n$, where $\alpha(G)$ is the independence number of G .

This talk is a survey on estimating the Ramsey function $r(F, K_n)$ for a fixed graph F and large n . To find good bounds for such function, many new ideas, techniques and methods have developed. Among these, probabilistic method, semi-random methods, random process, and algebraic method are often used.



Some results on graph partitions

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ABSTRACT

The *Maximum Bipartite Subgraph Problem* asks, for a given graph G , a partition of $V(G)$ into V_1 and V_2 such that the number of edges between V_1 and V_2 is maximum. The *Judicious Partition problems* ask a partition of $V(G)$ into V_1, V_2, \dots, V_k so that several quantities are optimized simultaneously. In this talk, we will present some new results and some still open problems on partitions of graphs. These are joint work mostly with X. Yu, and partially with G. Fan, R. Li, J. Yan, X. Zhang, and C. Zhou.



Planarity for Partially Ordered Set

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ABSTRACT

There is a rich history of results linking planar graphs with combinatorial properties of finite partially ordered sets. Early work focused on the interplay between dimension and planarity for the diagram. Recall that testing planarity for diagrams is NP-complete while planarity for graphs is linear in the number of edges. This was followed by the now classic work of Schnyder linking planarity for graphs back to dimension. Schnyder's directions were extended by Brightwell and Trotter to 3-connected graphs and then on to planar multigraphs. Felsner, in turn, developed a comprehensive theory for angle labelings, a key ingredient of the Schnyder theory. Most recently, Felser, Li and Trotter have investigated incidence posets of planar graphs, and in 2011, Streib and Trotter have completed the proof of the fact that the dimension of a poset having a planar cover graph is bounded as a function of its height.



Nullity, maximum nullity and zero forcing sets of graphs

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ABSTRACT

The nullity $\eta(G)$ of a graph G is the number of zero eigenvalues of the adjacency matrix of G . The nullity (rank) of a molecular graph G has a number of important applications in physical chemistry. In the first part of this talk, we explore connections between the graph structure of G and the number $\eta(G)$. Given a graph G on n vertices and a field F , the maximum nullity of G over F , denoted by $M^F(G)$, is the largest possible nullity over all $n \times n$ symmetric matrices over F whose (i, j) th entry (for $i \neq j$) is nonzero whenever ij is an edge in G and is zero otherwise. The maximum nullity problem of a graph G is to determine $M^F(G)$. This problem and its variations have received considerable attention over the years. In 2008, a new graph parameter $Z(G)$, the zero forcing number, was introduced to bound $M^F(G)$ from above. A number of interesting results on $M^F(G)$ were obtained by using techniques involved with $Z(G)$. In the second part of this talk, we will survey known results on maximum nullity problem and present our most recent results. This talk is based on joint works with Prof. Gerard J. Chang (National Taiwan University, Taiwan) and Dr. Liang-Hao Huang (National Central University, Taiwan).

KEYWORDS: Graph, rank, nullity, minimum rank, maximum nullity, spectrum, zero forcing set.

The Strong Chromatic Index of Cubic Halin Graphs



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ABSTRACT

A *strong edge coloring* of a graph G is an assignment of colors to the edges of G such that two distinct edges are colored differently if they are incident to a common edge or share an endpoint. The *strong chromatic index* of a graph G , denoted $s\chi'(G)$, is the minimum number of colors needed for a strong edge coloring of G . A Halin graph G is a plane graph constructed from a tree T without vertices of degree two by connecting all leaves through a cycle C . If a cubic Halin graph G is different from two particular graphs Ne_2 and Ne_4 , then we prove $s\chi'(G) \leq 7$.

This is a joint work with Daphne Der-Fen Liu, Department of Mathematics, California State University, Los Angeles, USA.

KEYWORDS: Halin graph, strong edge coloring, strong chromatic index.



On the strong edge coloring of Halin graphs

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ABSTRACT

A proper edge coloring of a graph G is an assignment of colors to the edges of G such that no two edges with a common vertex receive the same color. A strong edge coloring of G is a proper edge coloring, with the further condition that no two edges with the same color lay on a path of length three. The strong chromatic index of G , denoted by $s\chi'(G)$, is the minimum number of colors needed for a strong edge coloring of G . A Halin graph $G = T \cup C$ is a plane graph constructed from a tree T without vertices of degree 2 by connecting all leaves through a cycle C such that C is the boundary of the exterior face. Previously, Shiu et al. have studied the strong chromatic index of some classes of cubic Halin graphs. They also conjectured that $s\chi'(G) \leq s\chi'(T) + 4$ for all Halin graphs. In this talk, we settle this conjecture by proving a stronger result stated as follows:

If a Halin graph $G = T \cup C$ is different from a certain necklace Ne_2 and any wheel W_n with $n \not\equiv 0 \pmod{3}$, then we have $s\chi'(G) \leq s\chi'(T) + 3$.

KEYWORDS: Strong edge coloring, strong chromatic index, Halin graph.

Some topics on acyclic edge coloring of graphs



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ABSTRACT

Acyclic coloring problem is a specialized problem that arises in the efficient computation of Hessians. A proper edge coloring of a graph G is called acyclic if there is no 2-colored cycle in G . The acyclic chromatic index of G , denoted by $\chi'_a(G)$, is the least number of colors in an acyclic edge coloring of G . In 2001, Alon, Sudakov and Zaks stated the Acyclic Edge Coloring Conjecture, which says that $\chi'_a(G) \leq \Delta + 2$ for all graphs G .

Some results on acyclic edge coloring of graphs are given.

KEYWORDS: graph, edge coloring, acyclic, girth.



The (t, d, k) -tree coloring of graphs

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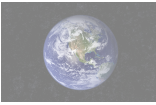
ABSTRACT

We associate positive integers $1, 2, \dots, t$ with colors, and call f a t -edge-coloring of a graph G if $f : E(G) \rightarrow \{1, 2, \dots, t\}$. For $1 \leq i \leq t$, let $E_i = \{e : f(e) = i\}$ and $E_i(v) = \{uv : u \in N_G(v) \text{ and } f(uv) = i\}$ for any vertex $v \in V(G)$. A t -edge-coloring f is called a t -tree-coloring of a graph G if each E_i induces a forest for any $1 \leq i \leq t$. Obviously, G has a t -tree-coloring if and only if G can be decomposed into t forests. f is called a (t, k, d) -tree-coloring of G if each E_i induces a forest of maximum degree at most k and diameter at most d . The (k, d) -arboricity $a_{k,d}(G)$ of G is minimum t such that G has a (t, k, d) -tree-coloring. This generalizes several well-known notions, such as the edge chromatic number $\chi'(G) = a_{1,1}(G)$, the arboricity $a(G) = a_{\Delta, \infty}(G)$, the k -arboricity $a_k(G) = a_{k, \infty}(G)$, the linear arboricity $la(G) = a_{2, \infty}(G)$, the star arboricity $sta(G) = a_{\Delta, 2}(G)$ and the linear k -arboricity $la_k(G) = a_{2,k}(G)$.

In this talk, we will introduce some recent results and problems on this topic.

KEYWORDS: graph, (t, k, d) -tree coloring, (k, d) -arboricity, edge coloring, linear arboricity.

The Linear k -Arboricity of Balanced Complete Multipartite Graphs



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ABSTRACT

A *decomposition* of a graph is a list of subgraphs such that each edge appears in exactly one subgraph in the list. If a graph G has a decomposition G_1, G_2, \dots, G_d , then we say that G_1, G_2, \dots, G_d decompose G . There are many interesting results and problems in the decomposition of graphs; one is to determine the *linear k -arboricity* of graphs.

A *linear k -forest* is a graph whose components are paths with lengths at most k . The minimum number of linear k -forests needed to decompose a graph G is the linear k -arboricity of G , denoted by $la_k(G)$. And we would like to determine the linear k -arboricity of every graph G . In fact, the notion of linear k -arboricity is a natural generalization of *edge coloring* and also a refinement of the concept of *linear arboricity* in which the paths have no length constraints.

In this talk, we are going to give a brief survey of some recent progress in the linear k -arboricity of balanced complete multipartite graphs.

KEYWORDS: Linear k -forest, Linear k -arboricity, Complete graph, Bipartite graph, Multipartite graph.



Oriented circuit double cover and circular flow and colouring

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ABSTRACT

For a set \mathcal{C} of directed circuits of a graph G that form an oriented circuit double cover, we denote by $I_{\mathcal{C}}$ the graph with vertex set \mathcal{C} , in which two circuits C and C' are connected by k edges if $|\underline{C} \cap \underline{C}'| = k$. Let $\Phi_c^*(G) = \min_{\chi_{\mathcal{C}}(I_{\mathcal{C}})}$, where the minimum is taken over all the oriented circuit double covers of G . It is easy to show that for any graph G , $\Phi_c(G) \leq \Phi_c^*(G)$. On the other hand, it follows from well-known results that for any integer $2 \leq k \leq 4$, $\Phi_c^*(G) \leq k$ if and only if $\Phi_c(G) \leq k$; for any integer $k \geq 1$, $\Phi_c^*(G) \leq 2 + \frac{1}{k}$ if and only if $\Phi_c(G) \leq 2 + \frac{1}{k}$. This papers proves that for any rational number $2 \leq r \leq 5$ there exists a graph G for which $\Phi_c^*(G) = \Phi_c(G) = r$. We also show that there are graphs G for which $\Phi_c(G) < \Phi_c^*(G)$.

KEYWORDS: graph, flow, circular flow number, series join, parallel join, edge rooted graph, circuit double cover.

Catalan Numbers Modulo a Prime Power



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ABSTRACT

We develop a systematic tool to calculate the congruences of some combinatorial numbers involving $n!$. Using this tool, we re-prove Kummer's and Lucas' Theorems. And also classify the congruences of the Catalan numbers $c_n \pmod{64}$ by only considering the binary representation $[n]_2$ of n . Several general properties for calculating $c_n \pmod{2^k}$ are developed. For instance, a formula with powers of 2 and 5 can evaluate $c_n \pmod{2^k}$ for any k . An equivalence $c_n \equiv_{2^k} c_{\bar{n}}$ can show a rough classification, where \bar{n} is the number obtained by shortening some runs of 0 and runs of 1 in the binary string $[n]_2$. By this equivalence relation, we observe that only few numbers in $[0, 2^k - 1]$ can be the congruences of $c_n \pmod{2^k}$ for $k \geq 2$. Besides, our newest study is on c_n modulo a odd prime power.

KEYWORDS: Prime power modulus, Catalan numbers, Kummer's Theorem, Lucas' Theorem.



On a conjecture on the balanced decomposition number

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ABSTRACT

The concept of balanced decomposition number was introduced by Fujita and Nakamigawa in connection with a simultaneous transfer problem. A *balanced colouring* of a graph G is a pair (R, B) of subsets $R, B \subseteq V(G)$ such that $R \cap B = \emptyset$ and $|R| = |B|$. A *balanced decomposition* of a balanced colouring (R, B) of G is a partition of vertices $V(G) = V_1 \cup V_2 \cup \dots \cup V_r$ such that $G[V_i]$ is connected and $|V_i \cap R| = |V_i \cap B|$ for $1 \leq i \leq r$. The *balanced decomposition number* $f(G)$ of a graph G is the maximum of $\max_{1 \leq i \leq r} |V_i|$, where the partition runs over all balanced decompositions of all balanced colourings of G . Fujita and Nakamigawa conjectured that If G is a 2-connected graph of n vertices, then $f(G) \leq \lfloor \frac{n}{2} \rfloor + 1$. The present paper confirms this conjecture.

KEYWORDS: Balanced decomposition (number), (minimally) 2-connected graph, cut-vertex, block, tree.

Some properties of graphs on matroids



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ABSTRACT

The circuit graph of a matroid M is a graph $G = G(M)$ with vertex set $V(G)$ and edge set $E(G)$ such that $V(G) = \mathcal{C}$ and $E(G) = \{CC' \mid C, C' \in \mathcal{C}, |C \cap C'| \neq 0\}$. The intersection graph of bases of a matroid $M = (E, \mathcal{B})$ is a graph $G = G^I(M)$ with vertex set $V(G)$ and edge set $E(G)$ such that $V(G) = \mathcal{B}$ and $E(G) = \{BB' : |B \cap B'| \neq 0, B, B' \in \mathcal{B}(M)\}$. The properties of paths, cycles and the connectivity of circuit graphs and intersection graph of bases of a matroid are discussed. Some new results obtained by us are given.

KEYWORDS: circuit graph, intersection graph, connectivity, Hamilton cycle, Matroid.



The Problems of Rankings on Sierpiński Graphs

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ABSTRACT

For a graph $G = (V, E)$, a *vertex* (*edge*, respectively) *t*-*ranking* is a *coloring* $c : V \rightarrow \{1, 2, \dots, t\}$ ($c' : E \rightarrow \{1, 2, \dots, t\}$, respectively) such that, for any two vertices u and v (edges e_x and e_y , respectively) with $c(u) = c(v)$ ($c'(e_x) = c'(e_y)$, respectively), every path between them contains an intermediate vertex w (edge e_w , respectively) with $c(w) > c(u)$ ($c'(e_w) > c'(e_x)$, respectively). The *vertex ranking number* $\chi_r(G)$ (*edge ranking number* $\chi'_r(G)$, respectively) is the smallest value of t such that G has a vertex (edge, respectively) *t*-*ranking*. The problem to find $\chi_r(G)$ ($\chi'_r(G)$, respectively) for a graph G is called the *vertex ranking problem* (the *edge ranking problem*, respectively). A partition of V is a set of nonempty subsets of V such that every vertex in V is in exactly one of these subsets. In this paper, we introduce two relations for ranking number of a graph. One is between vertex ranking number and vertex partitions, the other is between edge ranking number and vertex partitions. By using the proposed recurrence formulas, we derived the edge ranking number of the Sierpiński graph $\chi'_r(S(n, k)) = n\chi'_r(K_k)$ for any $n, k \geq 2$, and a bound of vertex ranking number of Sierpiński graphs $(n - 2)\chi'_r(K_k) + \chi_r(S''(n, k)) \leq \chi_r(S(n, k)) \leq (n - 2)\chi'_r(K_k) + \chi_r(S''(n, k)) + 1$ for any $n \geq 2$ and $k \geq 3$ where $S''(n, k)$ is the subgraph of $S(n, k)$ by removing all vertices of degree $k - 1$ from $S(n, k)$.

KEYWORDS: vertex ranking, edge ranking, coloring, vertex partitions, Sierpiński graphs.

MIS, MDS and MCDS Problems on Graphs of Bounded Parameter Treewidth with Applications on Ad Hoc Networks



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ABSTRACT

In this article, we generalize the concept of bounded treewidth to bounded parameter treewidth. We first define a class of graphs of bounded parameter treewidth. Given a graph of bounded parameter treewidth k_1 with its tree decomposition $(\{X_i | 1 \leq i \leq h\}, T)$, for each bag i , we further add an assumption on the upper bound k_2 on the number of vertices which are not in bag i but are in the descendants of i and which share an edge with any vertices in bag i . Under the above graph and assumption, we design polynomial algorithms for MIS, MDS and MCDS problems. For the MIS problem, the running time is $O(n^2n^{k_1})$. For the MDS problem, the time complexity is $O(n^2n^{k_1})$ and for the MCDS problem is $O(n^2n^{k_1})$.

KEYWORDS: Ad hoc networks, algorithm, tree decomposition, bounded parameter treewidth.



Varied domination problems in generalized Petersen graphs

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ABSTRACT

A vertex subset S of a graph G is a dominating set if each vertex in $V(G) - S$ is adjacent to at least one vertex in S . The domination number of G is the cardinality of a minimum dominating set of G , denoted by $\gamma(G)$. A dominating set S is called an independent dominating set if S is also an independent set. The independent domination number of G is the cardinality of a minimum independent dominating set of G , denoted by $\gamma_i(G)$. A dominating set S is called a total dominating set if each vertex v of G is dominated by some vertex $u \neq v$ of S . The total domination number of G is the cardinality of a minimum total dominating set of G , denoted by $\gamma_t(G)$.

In a generalized Petersen graph $P(n, k)$, its vertex set should be the union of $V = \{v_1, v_2, \dots, v_n\}$ and $U = \{u_1, u_2, \dots, u_n\}$, and its edge set be the union of $\{v_i v_{i+1}, v_i u_i, u_i u_{i+k}\}$ which all the subscripts are under addition modulo n and $1 \leq k \leq \lfloor \frac{n}{2} \rfloor$.

The exact values of $\gamma(P(2k+1, k))$, $\gamma(P(n, 1))$, $\gamma(P(n, 2))$, $\gamma_t(P(n, 2))$, and $\gamma(P(n, 3))$ have been determined. In this talk, we will show the exact values of $\gamma_i(P(2k+1, k))$, $\gamma_t(P(2k+1, k))$, $\gamma(P(2k, k))$, $\gamma_i(P(2k, k))$, $\gamma_t(P(2k, k))$, $\gamma_i(P(n, 1))$, $\gamma_t(P(n, 1))$, $\gamma_i(P(n, 2))$, $\gamma_i(P(n, 3))$ and a lower bound and an upper bound for $\gamma_t(P(n, 3))$.

KEYWORDS: generalized Petersen graph, domination, independent domination, total domination.

F_3 -domination number of graphs



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ABSTRACT

Let $G = (V, E)$ be a graph with vertex set V and edge set E , and let $S \subseteq V$. The set S is a *dominating set* if every vertex in $V - S$ is adjacent to at least one vertex of S . The set S is a *total dominating set* if every vertex in V is adjacent to at least one vertex of S , while S is a *restrained dominating set* if every vertex not in S is adjacent to a vertex in S and to a vertex in $V - S$. The set S is a *k-dominating set* if every vertex not in S is adjacent to at least k vertices in S . The *domination number* of G , denoted by $\gamma(G)$, is the minimum cardinality of a dominating set. A dominating set of G of cardinality $\gamma(G)$ is called a $\gamma(G)$ -*set*. The *total domination*, *restrained domination*, and *k-domination numbers* of G are defined similarly and are denoted by $\gamma_t(G)$, $\gamma_r(G)$, and $\gamma_k(G)$, respectively.

Chartrand et al. introduced a new mathematical framework for studying domination problem. A graph $G = (V, E)$ together with a fixed partition of its vertex set V into nonempty subsets is called a *stratified graph*. If the partition is $V = \{V_1, V_2\}$, then G is a 2-stratified graph and the sets V_1 and V_2 are called the *color classes* of G . We ordinarily color the vertices of V_1 red and the vertices of V_2 blue. Let F be a 2-stratified graph with one fixed blue vertex v specified. We say that F is rooted at the blue vertex v . A blue vertex v in a 2-stratified graph G is said to be *F-dominated* if it belongs to a copy of F (not necessarily induced in G) rooted at v . An *F-coloring* of a graph G is a red-blue coloring of the vertices of G such that every blue vertex v of G is *F-dominated*. The *F-domination number* $\gamma_F(G)$ of G is the minimum number of red vertices of G around all *F-colorings* of G .

It is clear that there are five possible choices when F is a 2-stratified path P_3 on three vertices rooted at a blue vertex. Chartrand et al. showed that the *F-domination number* of four of these five possible choices of F are the well known domination type parameters, the domination number, the total domination number, the restrained domination number, and the 2-domination number, except for the case that F is a 2-stratified path P_3 , rooted at one endvertex with another endvertex is colored red, and the vertex adjacent to the two endvertices is colored blue. Chartrand et al. called the domination problem of this type the *F₃-domination* problem.



In this talk, I will introduced some results about the F_3 -domination number of Caetesian product of graphs. Some of the relations between the F_3 -domination number and other domination type parameters, and the exact values of the F_3 -domination number of some graphs, such as $P_2 \times P_n$, $P_2 \times C_n$, $P_3 \times P_n$, $P_4 \times P_n$, are given.

KEYWORDS: Stratified graph, domination, F -domination, Cartesian product

Clique-transversal sets and 2-clique-coloring in planar graphs



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ABSTRACT

A *clique-transversal set* D of a graph $G = (V, E)$ is a subset of vertices of G such that D meets all cliques of G , where a clique is defined as a complete subgraph maximal under inclusion and having at least two vertices. The *clique-transversal number*, denoted by $\tau_C(G)$, of G is the minimum cardinality of a clique-transversal set in G . A *2-clique-coloring* of a graph is a 2-coloring of its vertices such that no clique is monochromatic. Erdős et al. proposed to find sharp estimates on $\tau_C(G)$ for planar graphs. In this paper we investigate the clique-transversal number of a planar graph. We first show that every outerplanar graph G of order n (≥ 2) has $\tau_C(G) \leq 3n/5$ and the bound is tight. Secondly, we present a polynomial-time algorithm to find a 2-clique-coloring in claw-free planar graphs without 4-cliques, other than odd cycles longer than three. As an immediate consequence, we give a sharp upper bound on the clique-transversal number for claw-free planar graphs without 4-cliques.

KEYWORDS: Clique-transversal set; Planar graph; Claw-free graph; Clique; 2-Clique-coloring; Algorithm.



The Dual Integrality of the Maximum-weight Stable Matching Problem

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ABSTRACT

Given a preference system (G, \prec) and an integral weight function defined on the edge set of the graph G , the maximum-weight stable matching problem is to find a stable matching of (G, \prec) with maximum total weight. In this talk, we consider this *NP*-hard problem using linear programming and polyhedral approaches. Theoretically, we show that the Rothblum system for defining the fractional stable matching polytope of (G, \prec) is totally dual integral if and only if this polytope is integral if and only if (G, \prec) contains no so-called semistable partitions with odd cycles. Algorithmically, we present a combinatorial polynomial-time algorithm for the maximum-weight stable matching problem and its dual on any preference system containing no semistable partitions with odd cycles. (Joint work with Guoli Ding, Xiaodong Hu, and Wenan Zang)

Hypergraphs and k -power domination



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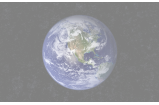
ABSTRACT

Let $H = (X, \varepsilon)$ be a hypergraph. A set $S \subseteq X$ is a k -power domination set of H if all vertices of X are observed according to the two following rules: (OR1) a vertex in the power domination set observes itself and all of its neighbors, (OR2(k)) If an observed vertex v is incident to at most k unobserved edges, that is edges containing unobserved vertices, then the unobserved edges become observed as well. This presentation is divided in three main sections. The first section deals with hypertrees. An hypertree is an hypergraph with no Berge-cycle. Equivalently, an edge is an hypertree, and an hypertree is obtained from an hypertree by taking a vertex v , adding an hyperedge $E = \{v\}$ and adding as many new vertices as desired in E . We will give an exact characterization of hypertrees with k -power domination $\gamma_p^k = t$. The second section deals with connected hypergraphs. We will give an upper bound for $\gamma_p^k(H)$ in terms of k and the number of vertices n of H , and characterize the hypergraphs achieving the bound, namely, if $H = (X, \varepsilon)$ is a connected hypergraph of order $n \geq k + 2$, then $\gamma_p^k(G) \leq \frac{n}{k+2}$ with equality if and only if $H \in \mathfrak{T}_k \cup \{K_{k+2, k+2}\}$, where \mathfrak{T}_k is defined as the family of hypergraphs obtained from connected hypergraphs H by adding $k + 1$ new vertices v_1 to and v_{k+1} to each vertex v of H , new edges $\{v, v_1\}$ to $\{v, v_{k+1}\}$, and optional edges $E \subseteq \{v_i\}$. In the third section, we will give a linear algorithm to solve the k -power domination problem on hypertrees.

KEYWORDS: Graph theory, hypergraph, power domination, algorithm.

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The cubic vertices of minimal bricks



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ABSTRACT

A graph is called a brick if it is 3-connected and bicritical. The importance of bricks stems from the fact that they are building blocks of the matching decomposition procedure as shown by Lovász [Matching structure and the matching lattice, *Journal of Combinatorial Theory, Ser. B* 43 (1987) 187-222]. A brick is minimal if for every edge e the deletion of e results in a graph that is not a brick. A vertex is called cubic if its degree is equal to three. M.H. de Carvalho, C.L. Lucchesi, and U.S.R. Murty [How to build a brick, *Discrete Mathematics* 306 (2006) 2383-2410] proved that every minimal brick has at least one cubic vertex. S. Norine and R. Thomas [Minimal bricks, *Journal of Combinatorial Theory, Series B* 96 (2006) 505-513] proved every minimal brick has at least three cubic vertices and conjectured that every minimal brick has a positive fraction of vertices which are cubic. In this paper, we prove that every minimal brick has at least four cubic vertices.



On critical groups of graphs formed by a graph operation

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ABSTRACT

Let G be a simple graph. Define $R(G)$ to be the graph obtained from G by adding a new vertex e corresponding to each edge $e = \{a, b\}$ of G and by joining each new vertex e to the end vertices a and b of the edge e corresponding to it. In this paper, we prove that the critical group of $R(G)$ is determined by critical group of G and give the smith form of critical of $R(G)$ in term of those of G .

KEYWORDS: Critical group, sandpile group, Laplacian matrix, graph operation.

Some Results on Cyclic Polytopes and an Introduction to Polymake System



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ABSTRACT

The moment curve $\gamma : \mathbf{R} \rightarrow \mathbf{R}^d$ defined parametrically by $\gamma(t) = (t, t^2, \dots, t^d)$. A *cyclic polytope* of dimension d with n vertices is a convex polytope combinatorially equivalent to the convex hull of n distinct points on a moment curve in \mathbf{R}^d . In this talk, we prove the *cyclic sieving phenomenon*, introduced by Reiner-Stanton-White, for faces of an even-dimensional cyclic polytope, under a group action that cyclically translates the vertices and introduce the polymake system. This talk is based on joint work with Sen-Peng Eu and Tung-Shan Fu.

KEYWORDS: cyclic sieving phenomenon, cyclic polytope, polymake.



Some coloring theorems of Kneser hypergraphs

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ABSTRACT

In 2004, Matoušek provided a fascinating combinatorial proof of the Kneser conjecture. Ziegler (2002) extended the scope of Matoušek's approach, by establishing a combinatorial proof of the hypergraph coloring theorem of Dol'nikov (1981). He also provided a combinatorial proof of Schrijver's theorem (1978). In this paper, we prove some coloring theorems of Kneser hypergraphs via the Octahedral Tucker's lemma and the Octahedral Fan's lemma.

KEYWORDS: Kneser hypergraphs, Dol'nikov theorem, Octahedral Tucker's lemma, Octahedral Fan's lemma

Acyclic List Edge Coloring of Graphs



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ABSTRACT

A proper edge coloring of a graph is said to be *acyclic* if any cycle is colored with at least three colors. The *acyclic chromatic index*, denoted $a'(G)$, is the least number of colors required for an acyclic edge coloring of G . An *edge-list* L of a graph G is a mapping that assigns a finite set of positive integers to each edge of G . An acyclic edge coloring ϕ of G such that $\phi(e) \in L(e)$ for any $e \in E(G)$ is called an *acyclic L -edge coloring* of G . A graph G is said to be *acyclically k -edge choosable* if it has an acyclic L -edge coloring for any edge-list L that satisfies $|L(e)| \geq k$ for each edge e . The *acyclic list chromatic index* is the least integer k such that G is acyclically k -edge choosable.

In a joint work with Ko-Wei Lih, we establish various upper bounds for the acyclic list chromatic indexes of subcubic graphs and several classes of planar graphs.

KEYWORDS: Acyclic list edge coloring, subcubic graphs, planar graphs.



Several Parameters of Divisor Graph

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ABSTRACT

In 2000 Singh and Santhosh [2] defined the concept of a divisor graph. They defined a divisor graph G as an ordered pair (V, E) where $V \subset \mathbb{Z}$ and for all $u, v \in V, u \neq v, uv \in E$ if and only if $u|v$ or $v|u$. Singh and Santhosh showed that every odd cycle of length five or more is not a divisor graph while all even cycles, complete graphs, and caterpillars are divisor graphs. In 2001, Chartrand, Muntean, Saenpholphant and Zhang [1] also studied divisor graphs. They let S be a finite, nonempty set of positive integers. Then, the divisor graph $DG(S)$ of S has S as its vertex set, and vertices i and j are adjacent if and only if either $i|j$ or $j|i$. A graph G is a divisor graph if $G \cong DG(S)$ for some nonempty, finite set S of positive integers. Hence, if G is a divisor graph, then there exists a function $f : V(G) \rightarrow \mathbb{N}$, called a divisor labeling of G , such that $G \cong DG(f(V(G)))$. The results of [2] are confirmed in [1], where it was shown that trees and bipartite graphs are divisor graphs and a characterization of all divisor graphs was given.

In this talk, I will discuss the independence number, the clique number, the vertex-chromatic number, the edge-chromatic number, and the bandwidth, etc. of $DG([n])$, where $[n]$ means the set $\{1, 2, 3, \dots, n-1, n\}$.

KEYWORDS: divisor graph, independence number, clique number, vertex-chromatic number, edge-chromatic number, bandwidth

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Splittable Graphs



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ABSTRACT

A graph G is said to be t -splittable if the edges of G can be decomposed into t isomorphic subgraphs. In this talk we will mention some results about the splittability of spiders, multipaths and star forests.

KEYWORDS: t -splittable graph, spider, multipath, star forest.



The Min-Max Network Routing Problem

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ABSTRACT

A *min-max network routing problem* can be specified by (G, w, R) , where $G = (V, A)$ is a graph, $w : A \rightarrow \mathbb{R}^+$ is a non-negative weight function defined on the edges of the graph, and $R = \{(s_i, t_i, d_i) \mid i = 1, 2, \dots, k\}$ is a set of routing requests. Each routing request (s_i, t_i, d_i) asks for d_i messages to be transmitted from some vertex s_i to another vertex t_i in the graph G . The graph G can be directed, undirected, or mixed graph. Each message must be transmitted along a path from s_i to t_i in G , but different paths may be used to transmit these d_i messages. When a message is transmitted along a path $s_i = v_0, v_1, \dots, v_r = t_i$, an amount $w(v_i, v_{i+1})$ of power is deducted from vertex v_i , $i = 0, 1, \dots, r - 1$. Assume that a set of paths \mathcal{P} to transmit all messages requested by R is given. Let $f_{\mathcal{P}}(v)$ for every vertex $v \in V$ be the total amount of power deducted from the vertex v . Let $f_{\mathcal{P}}(V)$ be the maximum of $f_{\mathcal{P}}(v)$ among all vertex $v \in V$. The network routing problem is: Given (G, w, R) , find a set of paths \mathcal{P} to transmit all messages such that the value $f_{\mathcal{P}}(V)$ is minimized. We show that when $k = 1$ and $d = 1$ the problem can be solved in polynomial time. We also show that most of the cases are NP-hard.

KEYWORDS: Min-max network routing problem, sensor network.

D -bounded Property in a Distance-regular Graph



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ABSTRACT

Let Γ denote a distance-regular graph with diameter D and intersection numbers $a_2 > a_1 = 0$. Let d be an integer with $1 \leq d \leq D$. Γ is said to be d -bounded whenever for any pair of vertices x, y with distance $\partial(x, y)$ at most d , there exists a regular weak-geodetically closed subgraph of diameter $\partial(x, y)$ which contains x and y . We show that for each $1 \leq d \leq D - 1$, if Γ contains no parallelograms of lengths up to $d + 1$ then Γ is d -bounded. By applying the above result we show the nonexistence of distance-regular graphs with classical parameters $(D, b, \alpha, \beta) = (D, -2, -2, ((-2)^{D+1} - 1)/3)$ for any D at least 4. This is a joint work with Yu-pei Huang and Yeh-jong Pan.

KEYWORDS: Distance-regular graph, classical parameters, parallelogram, weak-geodetically closed subgraph, D -bounded.



An efficient self-stabilizing algorithm for the minimal dominating set problem under a distributed scheduler

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ABSTRACT

This thesis considers designing efficient self-stabilizing algorithms for solving the minimal dominating set (MDS) problem. Let n denote the number of nodes in a distributed system. A self-stabilizing algorithm is said to be a t -move algorithm if when it is used, a given distributed system takes at most t moves to reach a legitimate configuration. In 2007, Turau proposed a $9n$ -move algorithm for the MDS problem under a distributed scheduler. Later, in 2008, Goddard et al. proposed a $5n$ -move algorithm for the MDS problem under a distributed scheduler. It is indeed a challenge to develop an algorithm that takes less than $5n$ moves under a distributed scheduler. The purpose of this thesis is to propose such an algorithm. In particular, we propose a $4n$ -move algorithm under a distributed scheduler; an example such that our algorithm takes $4n - 1$ moves to reach a legitimate configuration has also been proposed.

KEYWORDS: Self-stabilizing algorithms; Fault tolerance; Distributed computing; Graph algorithms; Domination.

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The mutually independent hamiltonian cycles on various interconnection networks-examples and theorems



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ABSTRACT

The existence of mutually independent hamiltonian cycles, abbreviated as MIHCs, have been studied on various interconnection networks and considered as an alternative way of enhancing the efficiency of message processing. In this talk, we will briefly survey the different approaches of constructing MIHCs on interconnection networks, and give a degree-based condition for the existence of MIHCs.

KEYWORDS: Hamiltonian cycles, mutually independent, interconnection networks.



Restricted Connectivity in Digraphs

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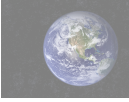
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ABSTRACT

We propose a new kind of restricted arc-connectivity $\lambda_k(D)$ and a new kind of restricted vertex-connectivity $\kappa_k(D)$ for digraph D . Let $L(D)$ be the line digraph of D . Neat results can be obtained for the relationship between $\lambda_k(D)$ and $\kappa_k(L(D))$, which shows the reasonability of our definitions. Furthermore, $\lambda_2(D)$ and $\kappa_2(D)$ coincide with the cyclic arc-connectivity $\lambda_c(D)$ and the cyclic vertex-connectivity $\kappa_c(D)$, respectively. Let $D_1 \times D_2$ be the Cartesian product of two digraphs. In our studies, we provide some upper bounds and some lower bounds for $\lambda_c(D_1 \times D_2)$ and $\kappa_c(D_1 \times D_2)$. In particular, $\lambda_c(C_{n_1} \times C_{n_2} \times \dots \times C_{n_k})$ and $\kappa_c(C_{n_1} \times C_{n_2} \times \dots \times C_{n_k})$ are completely determined, where C_{n_i} is a directed cycle of length n_i .

KEYWORDS: Graph theory, connectivity.

Weight distribution of Preparata codes over Z_4 and the construction of 3-designs



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ABSTRACT

In quaternary Preparata code \mathcal{P}_m , there are three kinds of types for the codewords of Hamming weight 7; types $1^6 2^1 3^0 0^{n-7} (1^0 2^1 3^6 0^{n-7})$, $1^4 2^1 3^2 0^{n-7} (1^2 2^1 3^4 0^{n-7})$ and $1^3 2^3 3^1 0^{n-7} (1^1 2^3 3^3 0^{n-7})$. In this paper, the parameter sets of 3-designs constructed from codewords of each type are given by computing the number of the codewords of each type. Moreover, it is determined that two classes of the 3-designs obtained are simple.

From Steiner Triple Systems to 3-Sun Systems



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ABSTRACT

An n -sun is the graph with $2n$ vertices consisting of an n -cycle with n pendent edges which form a 1-factor. In this paper we show that the necessary and sufficient conditions for the decomposition of complete tripartite graphs with at least two partite sets having the same size into 3-suns and give another construction to get a 3-sun system of order n , for $n \equiv 0, 1, 4, 9 \pmod{12}$. In the construction we metamorphose a Steiner triple system into a 3-sun system. We then embed a cyclic Steiner triple system of order n into a 3-sun system of order $2n - 1$, for $n \equiv 1 \pmod{6}$.

KEYWORDS: Steiner triple system, decomposition, 3-sun.

The Decycling Number of Outerplanar Graphs

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ABSTRACT

For a graph G , let $\tau(G)$ be the decycling number of G and $c(G)$ be the number of vertex-disjoint cycles of G . It has been proved that $c(G) \leq \tau(G) \leq 2c(G)$ for an outerplanar graph G . An outerplanar graph G is called *lower-extremal* if $\tau(G) = c(G)$ and *upper-extremal* if $\tau(G) = 2c(G)$. In this paper, we provide a necessary and sufficient condition for an outerplanar graph being upper-extremal. On the other hand, we find a class \mathcal{S} of outerplanar graphs none of which is lower-extremal and show that if G has no S -subdivision for all $S \in \mathcal{S}$, then G is lower-extremal.

KEYWORDS: decycling number, feedback vertex number, cycle packing number, outerplanar graph

This is a joint work with Hung-Lin Fu and Min-Yun Lien.

Optimal Anti-Pasch (2,3) packings



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ABSTRACT

Let X be a set of v points. A $(2, 3)$ -packing on X , shortly denoted by $\text{PTS}(v)$, is a pair (X, \mathcal{A}) , where \mathcal{A} is a set of 3-subsets (called *blocks*) of X , such that any pair of distinct points from X occurs together in at most one block. A $(2, 3)$ -packing (X, \mathcal{A}) of order n is called *maximum* if there does not exist any $(2, 3)$ -packing (X, \mathcal{B}) with $|\mathcal{A}| < |\mathcal{B}|$, and shortly denoted by $\text{MPTS}(v)$. In 1968, Spencer proved that an optimal $(2, 3)$ -packing of order v has $\lfloor \frac{v}{3} \lfloor \frac{v-1}{2} \rfloor \rfloor$ triples for $v \not\equiv 5 \pmod{6}$ and $\lfloor \frac{v}{3} \lfloor \frac{v-1}{2} \rfloor \rfloor - 1$ triples for $v \equiv 5 \pmod{6}$.

A *Pasch configuration*, also known as a *quadrilateral*, consists of four triples of a $(2, 3)$ -packing whose union is a set of six points, that is to say, four triples which must be of the form $\{a, b, c\}$, $\{a, y, z\}$, $\{x, b, z\}$ and $\{x, y, c\}$. A $\text{PTS}(v)$ is *anti-Pasch* or *quadrilateral-free* if it does not contain a Pasch configuration. We will denote such a system by $\text{QFPTS}(v)$. A $\text{QFMPTS}(v)$ is an optimal $\text{QFPTS}(v)$.

In this talk, we shall present some constructions of QFMPTS s and determine the existence of an optimal $\text{QFPTS}(v)$.

Existence of optimal $(v, \{3, 4\}, 1, Q)$ -OOCs for $Q \in \{\{1/3, 2/3\}, \{2/3, 1/3\}\}$



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ABSTRACT

Variable-weight optical orthogonal code (OOC) was introduced by Yang for multimedia optical CDMA systems with multiple quality of service (QoS) requirements. It is proved that optimal $(v, \{3, 4\}, 1, \{1/2, 1/2\})$ -OOCs exist for some complete congruence classes of v . In this paper, for $Q \in \{\{1/3, 2/3\}, \{2/3, 1/3\}\}$, by using skew starters, it is also proved that optimal $(v, \{3, 4\}, 1, Q)$ -OOCs exist for some complete congruence classes of v . The upper bound for the number of codewords of variable-weight OOCs is also improved.

KEYWORDS: Cyclic packing, optical orthogonal code, packing design, skew starter, variable-weight OOC.

Pooling designs for clone library screening in the inhibitor complex model



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ABSTRACT

In this paper we introduce inhibitors into the complex model and call it the inhibitor complex model. In this model, an inhibitor is a third type of complex, other than positive and negative, whose presence may cancel the effect of positive complexes. In the simplest inhibitor complex model, the 1-inhibitor complex model, the mere existence of a single inhibitor dictates the test outcome to be negative, regardless of the presence of positive complexes. If the requirement is changed from a single inhibitor to k inhibitors, then it is the k -inhibitor complex model. In general, in a (k, g) -inhibitor complex model, k inhibitors cancel the effect of g positive complexes. Usually, we don't know the two parameters k and g for sure. We will refer to a model without such specification the general inhibitor complex model. In this paper, we propose a efficient nonadaptive pooling design for the general inhibitor complex model, i.e., it works against any (k, g) -inhibitor complex model, and extend it to the error-tolerant case.

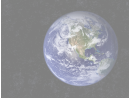
KEYWORDS: group test, pooling design, inhibitor, complex

A New Point of View on (k, m, n) -Selectors

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ABSTRACT

This talk mainly focuses on a combinatorial structure, (k, m, n) -selector, first introduced by De Bonis, Gąsieniec and Vaccaro (2005) in the context of designing efficient trivial 2-stage pooling strategies on the classic group testing problem. With (k, m, n) -selectors, De Bonis, Gąsieniec and Vaccaro provided the first asymptotically optimal 2-stage algorithm that uses a number of tests of the same order as the information-theoretic lower bound on the classic group testing problem. In addition, it has been proven useful for some other variations of group testing, including the inhibitor model and the mutually obscuring defectives model. This talk proposes a new point of view on (k, m, n) -selectors whereby we improve previous upper bounds on the size of selectors and bring the error-tolerance concept to selectors.

KEYWORDS: Group testing, selectors, pooling design.

Distance labeling with non-monotonic constraint



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ABSTRACT

A *distance labeling* of a graph is a mapping from the vertex set of that graph to the real line such that the (Euclidean) distance between two points depends on the distance between their pre-images in the graph with given conditions. In particular, we define the following labeling. Given nonnegative reals $\delta_1, \delta_2, \delta_3$, an $L(\delta_1, \delta_2, \delta_3)$ -*labeling* (or a *labeling with constraint* $(\delta_1, \delta_2, \delta_3)$) of a graph G is a function from $V(G)$ to the real line R such that $|f(u), f(v)| \geq \delta_i$ whenever $d_G(u, v) = i$ for $1 \leq i \leq 3$, where $d_G(u, v)$ is the distance between u and v in G . Notice that $|f(u) - f(v)|$ is the Euclidean distance between $f(u)$ and $f(v)$ in R .

The *span* of a labeling f is the difference of the maximum value and the minimum value of f on $V(G)$. The $L(\delta_1, \delta_2, \delta_3)$ *number* (or $L(\delta_1, \delta_2, \delta_3)$ -*span*) of G is the infimum span over all $L(\delta_1, \delta_2, \delta_3)$ -labelings. It can be shown that the infimum span is attainable, that is, a minimum.

We say the $L(\delta_1, \delta_2, \delta_3)$ -span is *monotone* if $\lambda(G; \delta_1, \delta_2, \delta_3) \geq \lambda(H; \delta_1, \delta_2, \delta_3)$ for all subgraphs of a graph G ; and is *hereditary* if the inequality is true for every induced subgraphs H of G . We show that if $\delta_2 \geq \delta_3$ then the $L(\delta_1, \delta_2, \delta_3)$ -span is hereditary. It is also monotone provided that $\delta_1 \geq \delta_2$. However, some examples tell us that if $\delta_1 < \delta_2$ then it is not monotone. That is the sequence $\langle \delta_1, \delta_2, \delta_3 \rangle$ is not monotonic. In the ordinary graph coloring, this kind of property of monotone seems obviously true, for example the chromatic number or the chromatic index but not in the distance labeling problem. Thus we are interested in this type of distance labelings. This article will consider the $L(1, d, 1)$ -labeling for real $d \geq 1$.

KEYWORDS: Graph coloring, distance.

On n -fold $L(j, k)$ - and circular $L(j, k)$ -labeling of graphs

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ABSTRACT

We initiate the research on multiple distance two labeling of graphs in this paper. For two sets of nonnegative integers I and I' , the distance between I and I' , $d(I, I')$, is defined as $\min\{|i - i'| : i \in I, i' \in I'\}$. Let n, j, k be positive integers. An n -fold $L(j, k)$ -labeling of a graph G is an assignment f of sets of nonnegative integers of order n to the vertices of G such that, for any two vertices u, v , $d(f(u), f(v)) \geq j$ if $uv \in E(G)$, and $d(f(u), f(v)) \geq k$ if $d_G(u, v) = 2$. Let f be an n -fold $L(j, k)$ -labeling of G . The span of f is the absolute difference between the maximum and minimum labels used by f . The n -fold $L(j, k)$ -labeling number of G is the minimum span over all n -fold $L(j, k)$ -labelings of G . The n -fold circular $L(j, k)$ -labeling number of a graph is defined accordingly.

We investigate the basic properties of the n -fold $L(j, k)$ - and circular $L(j, k)$ -labeling of graphs. The n -fold circular $L(j, k)$ -labeling numbers of trees, hexagonal lattice and p -dimensional square lattice are determined. The upper and lower bounds for the n -fold $L(j, k)$ -labeling numbers of trees are obtained. In most cases, these bounds are attainable. We also investigate the n -fold $L(j, k)$ - and circular $L(j, k)$ -labeling numbers of the triangular lattice, the hexagonal lattice, and the p -dimensional square lattice.

KEYWORDS: $L(j, k)$ -labeling number, circular $L(j, k)$ -labeling number, n -fold $L(j, k)$ -labeling number, n -fold circular $L(j, k)$ -labeling number, tree, triangular lattice, hexagonal lattice, p -dimensional square lattice.

Distance-two labeling problem on operation of graphs



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ABSTRACT

For given integers $p \geq q \geq 1$, a k - $L(p, q)$ -labeling of a graph G is a function f from the vertex set $V(G)$ to $\{0, 1, \dots, k\}$ such that $|f(u) - f(v)| \geq q$ if $d(u, v) = 2$ and $|f(u) - f(v)| \geq p$ if $d(u, v) = 1$. The $L(p, q)$ -labeling problem is to find the $L(p, q)$ -labeling number $\lambda_{p,q}(G)$ of a graph G which is the minimum cardinality k such that G has a k - $L(p, q)$ -labeling.

Given two graphs G and H , the *Cartesian product* of these two graphs, denoted by $G \square H$, is defined by $V(G \square H) = \{(u, v) \mid u \in V(G), v \in V(H)\}$ and $E(G \square H) = \{(u, x)(v, y) \mid (u = v, xy \in E(H)) \text{ or } (uv \in E(G), x = y)\}$. The *union* of G and H is the graph $G \cup H$ with $V(G \cup H) = V(G) \cup V(H)$ and $E(G \cup H) = E(G) \cup E(H)$. The *join* of G and H is the graph $G + H$ with $(G + H) = V(G) \cup V(H)$ and

$$E(G + H) = E(G) \cup E(H) \cup \{uv \mid u \in V(G) \text{ and } v \in V(H)\}.$$

In this talk, we would like to present some results on $L(p, q)$ -labeling for Cartesian products, join, and union of graphs.

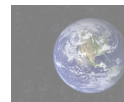
KEYWORDS: $L(p, q)$ -labeling, Cartesian products, join, union.

Path covering number and $L(2, 1)$ -labeling number of graphs

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ABSTRACT

A *path covering* of a graph G is a set of vertex disjoint paths of G containing all the vertices of G . The *path covering number* of G , denoted by $P(G)$, is the minimum number of paths in a path covering of G . An k - $L(2, 1)$ -*labeling* of a graph G is a mapping f from $V(G)$ to the set $\{0, 1, \dots, k\}$ such that $|f(u) - f(v)| \geq 2$ if $d_G(u, v) = 1$ and $|f(u) - f(v)| \geq 1$ if $d_G(u, v) = 2$. The $L(2, 1)$ -*labeling number* $\lambda(G)$ of G is the smallest number k such that G has a k - $L(2, 1)$ -labeling. The purpose of this paper is to study path covering number and $L(2, 1)$ -labeling number of graphs. Our main work extends most of results in [On island sequences of labelings with a condition at distance two, Discrete Applied maths 158 (2010), 1-7] and can answer an open problem in [On the structure of graphs with non-surjective $L(2, 1)$ -labelings, SIAM J. Discrete Math. 19 (2005), 208-223].

KEYWORDS: $L(2, 1)$ -labeling, Path covering number, Hole index

Vertex-graceful labelings for some double cycles



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ABSTRACT

A graph G with p vertices and q edges is said to be vertex-graceful if there exists a bijection $f : V(G) \rightarrow \{1, 2, \dots, p\}$ such that the induced labeling $f^+ : E(G) \rightarrow \mathbb{Z}_q$ defined by $f^+(uv) \equiv f(u) + f(v) \pmod{q}$, for each edge uv , is a bijection. Lee, Pan and Tsai showed some double cycles to be vertex-graceful with small order in 2005. In this paper, we will extend their result. In particular, a necessary condition for the vertex-gracefulness of double cycles is provided.

KEYWORDS: Strong vertex-graceful, strongly indexable, vertex-graceful, total edge-magic, super edge-magic, double cycle.

The circular $L(j, k)$ -labeling number of some graphs

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ABSTRACT

Let j, k and m be three positive integers, a *circular m - $L(j, k)$ -labeling* of a graph G is a function $f: V(G) \rightarrow \{0, 1, \dots, m-1\}$ such that $|f(u) - f(v)|_m \geq j$ if u and v are adjacent, and $|f(u) - f(v)|_m \geq k$ if u and v are at distance two, where $|a - b|_m = \min\{|a - b|, m - |a - b|\}$. The minimum m such that there exist a circular m - $L(j, k)$ -labeling of G is called the *circular- $L(j, k)$ -labeling number* of G and is denoted by $\sigma_{j,k}(G)$. In this speech, for any two positive integers j and k with $j \leq k$, we give some results about the circular $L(j, k)$ -labeling numbers of Cartesian product and direct product of path and cycle.

KEYWORDS: Cartesian product, direct product, circular labeling.

Chromatic Number of Distance Graphs Generated by the Sets $\{2, 3, x, y\}$



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ABSTRACT

Abstract: Let D be a set of positive integers. The distance graph generated by D has all integers \mathbb{Z} as the vertex set; two vertices are adjacent whenever their absolute difference falls in D . We completely determine the chromatic number for the distance graphs generated by the sets $D = \{2, 3, x, y\}$ for all values x and y . The methods we use include the density of sequences with missing differences and the parameter involved in the so called “lonely runner conjecture.” Previous results on this problem include: For x and y being prime numbers, this problem was completely solved by Voigt and Walther [2]; and other results for special integers of x and y were obtained by Kemnitz and Kolberg [1] and by Voigt and Walther [3].

This is a joint work with Aileen Sutedja.

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Existence of normal bimagic squares

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ABSTRACT

In this paper we provide a construction of normal bimagic squares by means of a magic pair of orthogonal general bimagic squares. It is shown that a normal bimagic squares of order mn exists for all positive integers m, n such that $m, n \notin \{2, 3, 6\}$, $m \equiv n \pmod{2}$ and a normal bimagic square of order $4m$ exists if and only if $m \geq 2$.

KEYWORDS: Magic rectangle, Magic square, Bimagic square, Magic pair, Latin square.

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Nowhere-zero Constant Sum Flows of Graphs



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ABSTRACT

For an undirected graph G , a zero-sum flow is an assignment of non-zero integers to the edges such that the sum of the values of all edges incident with each vertex is zero. Moreover a zero-sum k -flow is a zero-sum flow with edge labels $\pm 1, \pm 2, \dots, \pm(k-1)$. The zero-sum 6-flow conjecture raised by S. Akbari et al. in 2009 claims that any graph admitting a zero sum admits a 6-flow. We extend this notion zero-sum flow to a more general one in this paper, namely a **constant-sum flow**. The constant under a constant-sum flow is called an **index** of G , and $I(G)$ is denoted as the **index set** of all possible indices of G . Among others we completely determine the index sets of all r -regular graphs, and also the index sets for fans F_n and wheels W_n , which justifies the zero-sum 6-flow conjecture for fans and wheels as a byproduct. Moreover we find the minimum values of k , the **flow index**, for fans and wheels admitting zero-sum k -flows.

KEYWORDS: zero-sum flow, zero-sum k -flow, constant sum flow, flow index, index set.

This is joint work with Shi-Wei Hu.

Identification and Classification Problems on Pooling Designs for Inhibitor Complex Models

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ABSTRACT

Pooling designs are common tools to efficiently distinguish positive clones from negative ones in clone library screening. In some applications, there is a third type of clones called "inhibitors" whose effect is in a sense to obscure the positive clones in pools. Furthermore, a subset of clones (rather than a single clone), called a complex, can induce a positive effect. The group testing model which takes inhibitors (respectively complexes) into consideration is referred to as an inhibitor model (respectively a complex model). These two models have been studied in the group testing literature respectively. In this study, we allow the coexistence of inhibitors and complexes. We devoted our attention to nonadaptive algorithms (extended to the error-tolerance case). Both of identification and classification problems on pooling designs will be considered and pretty good answers will be mentioned in this talk.

K_3 -design of $K_{2n} \setminus F$ with F a spanning odd forest



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ABSTRACT

A K_3 -design of a simple graph G is a collection \mathcal{C} of edge-disjoint K_3 s of G such that every edge of G is contained in exactly one K_3 of \mathcal{C} . A graph G is said to be *3-sufficient* if every vertex of G is of even degree and the number of edges of G is divisible by 3. In this talk, we study the Conjecture: *If the graph $K_{2n} \setminus F$ is 3-sufficient, then it admits a K_3 -design, where F is a spanning odd forest.* Mainly, we prove that the Conjecture is affirmative for some variant F .

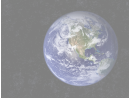
This is a joint work with Professor Hung-Lin Fu.

KEYWORDS: K_3 -design, 3-sufficient, spanning odd forest.

Hamiltonian properties in Cartesian product

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ABSTRACT

Ron Gould in [1] raised a research problem to find natural conditions to assure the product of two graphs to be hamiltonian. In this paper we investigate this problem in Cartesian product of graphs and present some sufficient and necessary conditions in terms of degree conditions.

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On an Open Problem of 4-ordered Hamiltonian Graphs



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ABSTRACT

A graph G is k -ordered if for any sequence of k distinct vertices of G , there exists a cycle in G containing these k vertices in the specified order. It is k -ordered Hamiltonian if, in addition, the required cycle is Hamiltonian. The question of the existence of an infinite class of 3-regular 4-ordered Hamiltonian graphs was posed in 1997 [1]. At the time, the only known examples were K_4 and $K_{3,3}$. Some progress was made in 2008 [2] when the Peterson graph was found to be 4-ordered and the Heawood graph was proved to be 4-ordered Hamiltonian; moreover an infinite class of 3-regular 4-ordered graphs was found. In this paper we show that a subclass of generalized Petersen graphs are 4-ordered and give complete classification for which of these graphs are 4-ordered Hamiltonian. In particular, this answers the open question regarding the existence of an infinite class of 3-regular 4-ordered Hamiltonian graphs. Moreover, a number of related results are presented.

KEYWORDS: Generalized Petersen graphs, Hamiltonian, 4-ordered.

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Heavy Subgraphs Conditions for Hamiltonian Graphs

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ABSTRACT

Let G be a graph. An induced subgraph H of G is called *heavy* if there exist two nonadjacent vertices in H such that their degree sum in G is at least $|V(G)|$. The graph G is called *H -heavy* if every induced subgraph isomorphic to H is heavy. In this talk we give several heavy subgraphs conditions for a graph to be hamiltonian. Our results extend several theorems on the existence of Hamilton cycles in graph under forbidden subgraphs conditions.

KEYWORDS: Heavy subgraph, Hamiltonian graph, forbidden subgraph.

完全 3-一致超圖的 Hamilton 圈分解



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ABSTRACT

超圖是有限集合的子集合系統，也叫有限集合的組合學。超圖是在離散數學中最複雜的離散結構，組合論中許多有限集合系統與超圖有關，如 Ramsey 理論，區組設計、有限幾何、網路理論、擬陣等。圖的分解是圖論的重要研究內容之一。

本文用數論，組合學以及計算方法等理論來研究完全 3-一致超圖的 Hamilton 圈分解，首先得到完全 3-一致超圖 K_n^3 邊的一種劃分，再此基礎上根據超圖的邊關聯要求定義邊序列和圈模型，這樣直接得到了一些 n ，完全 3-一致超圖 K_n^3 的 Hamilton 圈分解結果。為了得到更多 n ，完全 3-一致超圖 K_n^3 的 Hamilton 圈分解，我們在 K_n^3 邊的劃分基礎上建立摸方程，進而解決了部分素數的完全 3-一致超圖 K_n^3 的 Hamilton 圈分解。

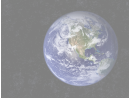
KEYWORDS: 超圖, 圈分解, Hamilton 圈分解

On the Dynamic Colorings of Graphs

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ABSTRACT

Let G be a graph. A coloring f is said to a dynamic k -coloring of G is a vertex coloring such that $|\{f(u) : u \in N(v)\}| \geq \min\{2, \deg(v)\}$ for every vertex v of G . The dynamic chromatic number $\chi_d(G)$ of G is the minimum number k such that G has a dynamic k -coloring. In 2001, B. Montgomery posed the following conjecture: *For any regular graph G , $\chi_d(G) \leq \chi(G) + 2$.* In this talk, we study the dynamic chromatic number of Kneser graph $KG(n, k)$, where $n \geq 2k + 1$. Mainly, we obtain the upper bounds of $\chi_d(KG(n, k))$ and exact values of $\chi_d(KG(n, k))$ for some n and k .

This is a join work with Professor Kuo-Ching Huang.

KEYWORDS: dynamic k -coloring, Kneser graph.

Minimum Identifying Code Graphs



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ABSTRACT

Let G be a graph and $B(u)$ be the set of u with all its neighbors in G . A set S of vertices is called an identifying code of G if, for every pair of distinct vertices u and v , both $B(u) \cap S$ and $B(v) \cap S$ are nonempty and distinct. A minimum identifying code of a graph G is a identifying code of G with minimum cardinality and $M(G)$ is the cardinality of a minimum identifying code for G . A minimum identifying code graph G of order n is a graph with $M(G) = \lceil \log_2(n + 1) \rceil$ having the minimum number of edges. Moncel constructed minimum identifying code graph of order $2^m - 1$ for integer $m \geq 2$ and leave the same problem of arbitrary order to be open. In this paper, we purposed the construction of connected minimum identifying code graphs to solve this problem of integer order larger than or equal to 4. Furthermore, we discussed some related properties.

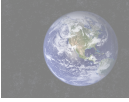
KEYWORDS: Identifying code, graph, power set.

WSNB Under New Compound Routing Strategies

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ABSTRACT

Chang et al. showed that the symmetric 3-stage Clos network or the multi-network is SNB if and only if it is WSNB under any of the five strategies: save the unused, packing, cyclic dynamic, and cyclic static. In this paper, we extend the strategies P and STU to six new strategies and get the same results for these strategies. We also consider the conditions of the vertical-copy network such that it is SNB if and only if it is WSNB under these six strategies.

Some new results for large sets and overlarge sets of Kirkman triple systems



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ABSTRACT

A large set of Kirkman triple systems of order v ($LKTS(v)$) is a partition of all triples of v -set X into $(v - 2)$ $KTS(v)$ s on X . An overlarge set of Kirkman triple systems ($OLKTS(v)$) is a partition of all triples of $(v + 1)$ -set X into $(v + 1)$ $KTS(v)$ s on v -set $X \setminus \{x\}$, $x \in X$. In this paper, we give some new results for large sets and overlarge sets of Kirkman triple systems.

KEYWORDS: Kirkman triple systems, large set, overlarge set.

Maps with highest level of symmetry that are even more symmetric than other such maps: Regular maps with largest exponent groups



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ABSTRACT

Regular maps are generalizations of Platonic solids and can be identified with two-generator presentations of groups G of the form $\langle x, y; x^2 = y^m = (xy)^n = \dots = 1 \rangle$; the parameters m and n are the degree and the face length of the map. Such maps have the ‘highest level’ of orientation-preserving symmetry among all maps. A regular map of vertex degree m is said to have exponent $j \in Z_m^*$ if the assignment $x \mapsto x$ and $y \mapsto y^j$ extends to an automorphism of G . Any exponent induces an automorphism of the underlying graph which can be viewed as an ‘external symmetry’ of the map. Exponents of a map form a subgroup of Z_m^* and hence Z_m^* is the theoretically largest possible group of exponents a regular map of degree m can have.

In this paper we show that for and given $m \geq 3$ there exist infinitely many finite regular maps of degree m with exponent group equal to Z_m^* . We also show that this result does not, in general, extend to regular maps of given degree and given face length.

KEYWORDS: Regular map, Triangle group, Exponent of a map, Cayley map.

Total weight choosability of Cartesian product of graphs



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ABSTRACT

A graph $G = (V, E)$ is called (k, k') -total weight choosable if the following is true: For any total list assignment L which assigns to each vertex x a set $L(x)$ of k real numbers, and assigns to each edge e a set $L(e)$ of k' real numbers, there is a mapping $f : V \cup E \rightarrow \mathbb{R}$ such that $f(y) \in L(y)$ for any $y \in V \cup E$ and for any two adjacent vertices x, x' , $\sum_{e \in E(x)} f(e) + f(x) \neq \sum_{e \in E(x')} f(e) + f(x')$ where $E(x)$ is the set of edges of G incident to x . In this paper, we prove that if G is the Cartesian product of an even number of even cycles, or the Cartesian product of an odd number of even cycles and at least one of the cycles has length $4n$ for some positive integer n , then G is $(1, 3)$ -choosable. In particular, hypercubes of even dimension are $(1, 3)$ -choosable. Moreover, we prove that if G is the Cartesian product of a path and a cycle of length $2n$ for some positive integer n , then G is $(1, 3)$ -choosable. In particular Q_3 is $(1, 3)$ -choosable.

KEYWORDS: Cartesian product, Total weight choosable

The extremal energies of weighted trees and forests with fixed total weight sum

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ABSTRACT

Let $\mathcal{T}_{n,K}$, and $\mathcal{F}_{n,K}$, be the set of positively weighted trees, and forests, of order n with the (fixed) total weight sum K , respectively. In this paper, we determine the minimal energy together with the unique extremal weighted graph achieving the minimal energy for both the classes $\mathcal{T}_{n,K}$ and $\mathcal{F}_{n,K}$. We also determine the maximal energy together with all the extremal weighted graphs achieving the maximal energy for the class $\mathcal{F}_{n,K}$, and show that there does not exist weighted graphs in the class $\mathcal{T}_{n,K}$ having the largest energy. Some further related problems are also considered.

KEYWORDS: Graph, Energy, Weighted graph, Matrix, Singular value.

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Skew energy of graphs

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ABSTRACT

let $D = (V, E)$ be a direct graph with order $n = |V| > 1$. The associated skew matrix $S(D)$ is defined as the skew matrix $S(D) = (s_{ij})$ where $s_{ij} = 1$ if and only if there is a direct arc from vertex v_i to vertex v_j , and $s_{ij} = -s_{ji}$ for all i, j (thus $s_{ii} = 0$ for all $i = 1, \dots, n$). The skew energy of the direct graph D is defined as the sum $\sum_{j=1}^n |\lambda_j|$ where $\Gamma = \{\lambda_1, \lambda_2, \dots, \lambda_n\}$ is the spectrum of $S(D)$. The skew energy of an undirected graph G is defined as the maximum of energies over all the possible orientations of G . In this paper we will investigate the energy of some special graphs.

KEYWORDS: Graph theory, energy, orientation.

On the Estrada Index

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ABSTRACT

The Estrada index of a graph G is defined as

$$EE(G) = \sum_{i=1}^n e^{\lambda_i},$$

where $\lambda_1, \lambda_2, \dots, \lambda_n$ are the eigenvalues of the adjacency matrix of G . We report some results on the Estrada index, including bounds, extremal graphs, etc.

KEYWORDS: eigenvalues, adjacency matrix, Estrada index.

Local bases of imprimitive sign patterns

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ABSTRACT

In 2007, L. You, J. Shao and H. Shan study the base for non-powerful irreducible sign patterns. In 2009, L. Wang, Z. Miao and C. Yan introduced the concept of the local base of primitive non-powerful signed digraph. Recently, H. Ma and Z. Miao described the extremal imprimitive non-powerful sign pattern matrices respect to the maximum base of You, Shao and Sahn. In this paper, we extended the concept of the local bases of primitive non-powerful signed digraphs to imprimitive sign pattern matrices and give the sharp upper bounds of the local base of the reducible non-powerful sign patterns and the upper bound of the local base of the irreducible non-powerful sign patterns with period p . Moreover, we also described the extremal patterns of the local base of the reducible non-powerful sign patterns.

On the spectral radius of graphs and its applications

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ABSTRACT

The spectral radius of a graph is the largest eigenvalue of its adjacency matrix. This report introduces upper and lower bounds for the spectral radius of graphs. The application of the spectral radius for chromatic number, energy of graphs is also considered.

KEYWORDS: adjacency matrix, spectral radius, upper bound, lower bound, chromatic number, energy.

Graphs with Extremal Energy

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ABSTRACT

The energy of a graph is the sum of the absolute values of the eigenvalues of its adjacency matrix. The edge grafting operation on a graph is a kind of edge moving between the two pendent paths starting from the same vertex. In this article we show how the graph energy changes under the edge grafting operations on unicyclic and bipartite graphs. We also give some applications of this result on the comparison of graph energies between unicyclic or bipartite graphs and on a conjecture about the tree of order n with the fourth maximal energy.

KEYWORDS: Graph, Tree, Energy, Grafting, Quasi-ordering.

Hedetniemi's conjecture is true on the some expansion transformation of the graph.

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ABSTRACT

This paper introduces the expansion transformation of the graph and maximum expansion graph at first .Then proves that Hedetniemi's conjecture is true

1. on the infinite maximum expansion classes of the graph ;
2. on the some expansion transformation of the graph.

Combinatorial congruences via the Zeilberger algorithm

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ABSTRACT

The well known Zeilberger algorithm is an effective tool for proving combinatorial identities. In this talk we will show how to use Zeilberger's algorithm to deduce some combinatorial congruences. In particular, we will exhibit the author's recent solution to the remaining open cases of Rodriguez-Villegas' conjectured congruences on

$$\sum_{k=0}^{p-1} \frac{\binom{2k}{k}^2 \binom{3k}{k}}{108^k}, \quad \sum_{k=0}^{p-1} \frac{\binom{2k}{k}^2 \binom{4k}{2k}}{256^k}, \quad \sum_{k=0}^{p-1} \frac{\binom{2k}{k} \binom{3k}{k} \binom{6k}{3k}}{12^{3k}}$$

modulo p^2 , where p is a prime greater than 3.

KEYWORDS: Zeilberger's algorithm, combinatorial congruences, binomial coefficients.

Some recent progress on combinatorial additive prime number theory

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ABSTRACT

We introduce some recent progress on combinatorial additive prime number theory.

Skew-standard tableaux with bounded height

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ABSTRACT

Let \mathcal{T}_3 be the three-rowed strip. Regev conjectured that the number of standard Young tableaux with $n - 3$ entries in the “skew three-rowed strip” $\mathcal{T}_3/(2, 1, 0)$ is $m_{n-1} - m_{n-3}$, a difference of two Motzkin numbers. This conjecture, together with hundreds of similar identities, were derived automatically and proved rigorously by Zeilberger via his powerful program and WZ method. It appears that each one is a linear combination of Motzkin numbers with constant coefficients. In this talk we will first survey the literature for the tableaux counting with bounded height, then introduce a simple bijection between Motzkin paths and standard Young tableaux with at most three rows. With this bijection we answer Zeilberger’s question affirmatively that there is a uniform way to construct bijective proofs for all of these identities. Finally, this scheme will be generalized to solve two other conjectures about standard tableaux with bounded height, one of which is also by Zeilberger.

KEYWORDS: Standard Young tableaux, Motzkin numbers, Motzkin paths

Partitioned difference families and almost difference sets

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ABSTRACT

Partitioned difference families(PDFs) were first studied by Ding and Yin in conjunction with the construction of constant composition codes(CCCs).In 2008,Yin et al. presented the constructions of a number of infinite classes of PDFs based on known difference sets in $GF(q)$. In this talk, we further investigate the constructions of PDFs by using known almost difference sets in $GF(q)$, and establish some recursive constructions of PDFs.As their applications,we also get a number of perfect difference systems of sets(DSSs)over Z_{q^2} with q odd prime.

KEYWORDS: Partitioned difference families(PDFs), difference sets, almost difference sets, difference systems of sets(DSSs), cyclotomic classes.

The Subset Sum Problem over Finite Abelian Groups

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ABSTRACT

Let A be an abelian group. Let $D \subseteq A$ be a finite subset of n elements. For a positive integer $1 \leq k \leq n$ and an element $b \in A$, let $N_D(k, b)$ denote the number of k -element subsets $S \subseteq D$ such that $\sum_{a \in S} a = b$. The decision version of the subset sum problem over D is to determine if there is a non-empty subset $S \subseteq D$ such that $\sum_{a \in S} a = b$, that is, if $N_D(k, b) > 0$ for some $1 \leq k \leq n$. This is a well known **NP**-complete problem and it naturally arises from a number of important applications in coding theory and cryptography. In this talk, a new combinatorial approach to this problem will be presented. This is a joint work with Prof. Wan Daqing.

KEYWORDS: subset sum problem, finite abelian group.

Algebraic and Combinatorial Constructions for Optimal Frequency-Hopping Sequences

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ABSTRACT

Frequency hopping (FH) sequences play a key role in frequency hopping spread spectrum communication systems. In order to evaluate the performance of FH sequences, Lempel and Greenberger (1974) and Peng and Fan (2004) derived lower bounds on their Hamming auto- and cross-correlations. In this talk, we will present several constructions for families of FH sequences with Hamming correlations meeting those bounds by algebraic techniques. We will also provide a combinatorial characterization for families consisting of multiple FH sequences, where a correspondence between families of frequency-hopping (FH) sequences and partition-type cyclic difference packings will be established. By means of this correspondence, many infinite classes of optimal FH sequences will be constructed by combinatorial approach.

KEYWORDS: Frequency hopping sequences, difference packings, frequency hopping spread spectrum communication systems.

Generalized ordinary sum and P -partitions

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ABSTRACT

We define a new operation \oplus_R on posets which generalizes the ordinary sums. By applying two simplification rules applying on posets, we provide an algorithm to compute the recursions of the generating functions for P -partitions of posets $A \oplus_{R_1} P \oplus_R \cdots \oplus_R P \oplus_{R_2} B$, where P repeats n times.

KEYWORDS: generating function, P -partition, ordinal sum, partition analysis, plane partition.

Quaternary sequence with optimal autocorrelation properties

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ABSTRACT

In this talk, we will give a well-rounded review of quaternary sequence with optimal autocorrelation. Firstly, we recall some optimal analysis of the autocorrelation of quaternary sequence. Then we summarize the known constructions of quaternary sequence with optimal autocorrelation, in which the constructions by using inverse Gray mapping will be introduced in detail.

KEYWORDS: Quaternary sequence, autocorrelation, Gray mapping.

Super-simple Properties and Constructions of Orthogonal Arrays



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ABSTRACT

Orthogonal arrays (OAs) belong to an important and high-profile area of combinatorics. They have been the subject of much study. This talk presents two recent constructions for OAs of strength $t \geq 3$, and explore an equivalence between super-simple OAs and optimal detecting arrays which are proposed by Colbourn and McClary in their recent research on computer software tests in component-based systems.

KEYWORDS: orthogonal arrays, constructions, super-simple.

Multi-sweep maximal neighborhood search and interval graphs

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ABSTRACT

A Maximal Neighborhood Search (MNS) on a graph G produces an ordering of its vertices, say v_1, \dots, v_n , for which we cannot find $i < j$ such that $N_G(v_i) \cap \{v_1, \dots, v_{i-1}\}$ is a proper subset of $N_G(v_j) \cap \{v_1, \dots, v_{i-1}\}$.

I will talk about my recent joint work with Peng Li on gathering information about (proper) interval graphs and recognizing the structure of (proper) interval graphs with either membership or non-membership certificates by employing multiple sweeps of Maximal Neighborhood Search. Some of our results only apply for the so-called Lexicographic Breadth-First Search, a specific but important Maximal Neighborhood Search.

KEYWORDS: Multi-sweep graph search, linear time certifying algorithm, interval graph, proper interval graph, MNS end-vertex.

Counting Isomers by Pólya's theorem — two examples



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ABSTRACT

This talk introduces two examples of the isomer-enumeration problems: one is 'Alkane' which is known as the classical example in isomer-enumeration study, the other is the so-called 'cyclacized polyphenacenes' which attracts much attentions of both chemists and mathematicians in recent years. In these two examples, the well-known Pólya's enumeration theorem (also called the Redfield-Pólya's Theorem) plays an important role.

KEYWORDS: isomer, enumeration, alkane, cyclacized polyphenacenes, Pólya's enumeration theorem.

Edge-transitive dihedral or cyclic covers of cubic symmetric graphs of order $2p$

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ABSTRACT

A regular cover of a connected graph is called *dihedral* or *cyclic* if its transformation group is dihedral or cyclic, respectively. Let X be a connected cubic symmetric graph of order $2p$ for a prime p . Several publications have been put into investigation of the classification of edge-transitive dihedral or cyclic covers of X for some specific p . It is known that the edge-transitive dihedral covers of X were classified for $p = 2$ and the edge-transitive cyclic covers of X were classified for $p \leq 5$. In this paper an extension of the above results to an arbitrary prime p is presented.

KEYWORDS: Symmetric graph, Edge-transitive graph, Regular cover

Bijection for linear trees and RNA secondary structures

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ABSTRACT

Some recursion formulas or analytical expressions for the exact enumeration of various types of constrained RNA secondary structure have been published. This paper gives a new bijection between RNA secondary structure and linear trees and some completely explicit closed formulas corresponding to the recursion formulas.

KEYWORDS: Bijection, Linear trees, RNA secondary structure

On Simsun and Double Simsun Permutations Avoiding a Pattern of Length Three

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ABSTRACT

A permutation σ of $\{1, \dots, n\}$ is simsun if for all k , the subword of σ restricted to $\{1, \dots, k\}$ does not have three consecutive decreasing elements. The permutation σ is double simsun if both σ and σ^{-1} are simsun. In this talk, a new bijection between simsun permutations and increasing 1-2 trees is presented, and a number of interesting consequences of this bijection in the enumeration of pattern-avoiding simsun and double simsun permutations are shown. The double simsun permutations that avoid each pattern of length three are enumerated. This talk is based on joint work with Wan-Chen Chuang, Sen-Peng Eu, and Yeh-Jong Pan.

KEYWORDS: simsun permutation, pattern-avoiding, increasing 1-2 tree, Motzkin path, Catalan number, Motzkin number, secondary structure number, Fibonacci number

List Double-Critical Graphs

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ABSTRACT

A connected k -chromatic graph G is double-critical if for all edges uv of G the graph $G - u - v$ is $(k - 2)$ -colorable. A long-standing conjecture, due to Erdős and Lovász, states that the complete graphs are the only double-critical graphs.

A connected graph G is called edge double-critical if it contains some pairs of nonadjacent edges, and $\chi(G - e_1 - e_2) = \chi(G) - 2$ for any two nonadjacent edges $e_1, e_2 \in E(G)$, where $\chi(G)$ denotes the chromatic number of G . Kawarabayashi et al. and later, Lattanzio proved that the complete graphs are the only edge double-critical graphs. We provide another simple proof of this theorem.

We introduce the notions of list double-critical graphs, and show that for a graph G , if $ch(G - u - v) = ch(G) - 2$ for any vertices $u, v \in V(G)$, then G is a complete graph, where $ch(G)$ denotes the choice number of G . We also prove that the complete graphs are the only edge list double-critical graphs.

We also conjecture that complete graphs are only list double-critical graphs, and confirm that this is true for a list double-critical graphs with choice number at most four.

KEYWORDS: Chromatic number, List coloring, Double-critical graph.

On normal Bases and their multiplication tables

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ABSTRACT

We study properties of multiplication tables of normal bases over finite fields. We also characterize self-dual normal bases and complete normal bases by their multiplication tables.

KEYWORDS: circulant matrices, complete normal bases, dual basis, finite fields, multiplication tables, normal bases, system of quadratic forms.

Mean and Variance for Shape Parameters of Random Tries and Related Structures



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ABSTRACT

Tries are one of the most important data structures on words with numerous applications. Consequently, shape parameters of tries have attracted a lot of attention over the last three decades. In previous studies, shape parameters have been investigated case by case. In our talk, we will discuss a general framework for deriving mean and variance for additive shape parameters under the Bernoulli model. Our framework will unify and simplify previous approaches. Moreover, our approach is capable of yielding different (and sometimes simpler) expressions for involved constants and more information about involved periodic functions. Variations of our framework can also be applied to algorithms and data structures closely related to tries such as PATRICIA tries, contention trees, leader election algorithms, RFID, radix sort, etc. This is joint work with V. Zacharovas (Vilnius University) and H.-K. Hwang (Academia Sinica).

KEYWORDS: Tries, mean, variance, additive shape parameters, Poisson generating function, poissonization, Mellin transform.

Operations of graphs and unimodality of independence polynomials

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ABSTRACT

In this talk, we first give a brief survey on unimodality problems for independence polynomials of graphs and then present some of our recent results for certain classes of graphs.

KEYWORDS: Independence polynomials, unimodality, log-concavity, real zeros, operators on graphs.

Intersecting Antichains and Shadows in Linear Lattices

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ABSTRACT

We establish a homomorphism of finite linear lattices onto the Boolean lattices via a group acting on linear lattices. By using this homomorphism we prove the intersecting antichains in finite linear lattices satisfy an LYM-type inequality, as conjectured by Erdős, Faigle and Kern, and we state a Kruskal-Katona type theorem for the linear lattices.

KEYWORDS: Boolean lattice, Erdős–Ko–Rado theorem, intersecting family, Kruskal-Katona theorem, linear lattice

q -series and $U(n + 1)$ extension

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ABSTRACT

The basic hypergeometric series is also called q -series, which is the important subject of modern mathematics. It can be applied to combinatorics, number theory, Special function, Lie algebra theory, Quantum theory, Statistics and soon. It is made of many famous transformations formulas. The multiple variables of basic hypergeometric series with root system A_n ($U(n + 1)$), C_n and D_n were studied by many researches. In this report, we will give $U(n + 1)$ extension of some q -series identities involving Agarwal-Andrews-bressoud Bailey pair and Rogers-Szego polynomials etc..

KEYWORDS: Bailey pair, q -series, q -exponential operator, q -series

Independent Sets in Direct Products of Vertex-transitive Graphs



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ABSTRACT

The direct product $G \times H$ of graphs G and H is defined by:

$$V(G \times H) = V(G) \times V(H)$$

and

$$E(G \times H) = \{[(u_1, v_1), (u_2, v_2)] : (u_1, u_2) \in E(G) \text{ and } (v_1, v_2) \in E(H)\}.$$

In this paper, we will prove that the equality

$$\alpha(G \times H) = \max\{\alpha(G)|H|, \alpha(H)|G|\}$$

holds for all vertex-transitive graphs G and H , which provides an affirmative answer to a problem posed by Tardif (Discrete Math. 185 (1998) 193-200). Furthermore, the structure of all maximum independent sets of $G \times H$ are determined.

KEYWORDS: direct product; primitivity; independence number; vertex-transitive.