Contributed Talk Sessions

Contributed Talks IA, Friday 2:25-3:35pm.

2:25-2:45 **Nassim Sohaee**, University of Texas at Arlington.
Title: *Approximate Algorithm for Finding maximum upward emeddable sub-digraph of an acyclic Digraph.*
Abstract: Generally, finding a drawing of a digraph on an orientable surface, having all edges continuously pointing in a certain direction, with is an upward drawing, is an NP-complete problem. In this paper, we are going to present a polynomial time algorithm to find an approximate upward drawing on the plane and sphere. For this purpose, we will define an overlap graph corresponding to the given digraph, and use Gavril's algorithm to find an upward drawing with 3/4 size of optimal solution.

2:50-3:10 **Sangho Shim**, Georgia Institute of Technology. Joint with Jozef Siran and Janez Zerovnik.
Title: *On routing problems.*
Abstract: In this talk we disprove the uniform shortest path routing conjecture for vertex-transitive graphs by constructing an infinite family of counterexamples.We also discuss quasi-Cayley graphs to construct a good network model.

3:15-3:35 **Jian Shen**, Texas State University-San Marcos. Joint with Li Sheng and Jie Wu.
Title: *Searching for sorted sequences of kings in tournaments.*
Abstract: A tournament is a directed graph with exactly one edge between each pair of vertices. A king in a tournament is a vertex from which every other vertex is reachable by a path of length at most 2. A sorted sequence of kings in a tournament is an ordered list of its vertices $u_1, u_2, \ldots, u_n$ such that, for each i, u_i beats u_{i+1} and u_i is a king in the subtournament induced by $\{u_j : i \leq j \leq n\}$. In particular, if we are told that the tournament is transitive, searching for a sorted sequence of kings is equivalent to sorting a set of n numbers, which needs $\Theta(n \log n)$ comparisons. We are interested in finding a sorted sequence of kings in a general tournament by asking the following type of binary questions: "What is the orientation of the directed edge between two specified vertices u, v?" The cost for finding a sorted sequence of kings is the minimum number of binary questions asked in order to guarantee the finding of a sorted sequence of kings. We find an algorithm to solve the problem with cost at most $8\sqrt{2}n^{3/2}/3$. On the other hand, we prove that no algorithm can solve the problem with cost less than $\sqrt{3}n^{3/2}/3$ in the worst case. Thus the exact order of magnitude, $\Theta(n^{3/2})$, for the cost of finding a sorted sequence of kings in a tournament is settled. This is a joint work with Li Sheng (Drexel University) and Jie Wu (Florida Atlantic University).

Contributed Talks IB, Friday 2:25-3:35pm.

2:25-2:45 **Joshua N. Cooper**, Courant Institute, NYU. Joint with Joel Spencer.
Title: *Simulating a Random Walk with Constant Error.*
Abstract: We show that Jim Propp's P-machine, a deterministic process that runs on Z^d, approximates a simple random walk within a constant. The proof uses delicate estimates and an interesting alternating sum. We discuss several intruiging conjectures. Joint work with Joel Spencer.

2:50-
3:10

Jeremy Martin, University of Minnesota. Joint with Victor Reiner.
Title: *Towards a bijective enumeration of spanning trees of the hypercube.*
Abstract: Cayley's formula n^{n-2} for the number of spanning trees of the complete graph on n vertices can be proved bijectively using Pruefer coding. The problem that motivated this research is to find an analogous bijection for spanning trees of the n-dimensional hypercube Q_n. A nice combinatorial formula is known (see Stanley's Enumerative Combinatorics, volume 2, p. 62); however, we know of no bijective proof. Our results give explicit (and concise) factorizations of generating functions that enumerate spanning trees by certain elementary statistics. We hope that these results will lead to an eventual solution of the original problem. The algebraic techniques used can also be applied to give factorizations of generating functions for spanning trees of other classes of graphs, namely complete multipartite and threshold graphs. This is joint work with Victor Reiner.

3:15-
3:35

Art Duval, University of Texas at El Paso.
Title: *Port complexes and the Laplacian spectral recursion.*
Abstract: The Laplacian spectral recursion expresses the eigenvalues of the combinatorial Laplacian of a simplicial complex K in terms of the eigenvalues of $K-e$, K/e, and $(K-e, K/e)$, which are, respectively, the deletion with respect to a ground element e, the contraction with respect to e, and the relative simplicial complex of the deletion modulo the contraction. The collection of simplicial complexes satisfying this recursion includes matroid complexes and shifted complexes, and is also closed under, among other operations, canonical Alexander duality. Matroid complexes are not closed under Alexander duality, but port complexes, which generalize both matroid complexes and their Alexander duals, are. I conjecture that port complexes also satisfy the Laplacian spectral recursion.

Contributed Talks IIA, Friday 4:10-4:55pm.

4:10-
4:30

Dimitrije Kostic, Texas A&M University.
Title: *Coping with Lies While Searching Bounded Spaces.*
Abstract: Searching a bounded space for a predetermined element using only answers to simple yes-no questions becomes difficult when the answers to the questions can be erroneous. Nevertheless, these searching scenarios model important situations in industry, aside from being interesting in their own right. Algorithms and worst-case lengths of search strategies will be examined under various conditions on the search.

4:35-
4:55

Annela Kelly, University of Louisiana at Monroe.
Title: *One-pile misere Nim for three or more players.*
Abstract: The analysis of several variants of the classical game Nim uses binary numbers (Berlekamp, Gardener). There is a great interest in generalizations and modifications of the game. We will consider one-pile Nim misere modification for more than two players. In case of three or more players, the standard theory of impartial games does not readily apply. In this talk we analyze the game in a variety of cases involving alliances formed by the players.

Contributed Talks IIB, Friday 4:10-4:55pm.

4:10-4:30 **Michael Reid**, University of Central Florida.
Title: *Tile Homology and Tile Homotopy Groups.*
Abstract: In 1990, Conway and Lagarias published a method to analyze some types of polyomino tiling problems by means of finitely presented groups. In general, working with finitely presented groups can be difficult. We give a strategy for working with the resulting groups, and consequently produce numerous interesting tiling results.

4:35-4:55 **Douglas J. Klein**, Texas A&M University at Galveston.
Title: *Intrinsic Metrics on Graphs.*
Abstract: Graphs appear as simplified representations of a diversity of real-world structures. Naturally there is a question of an intrinsic graph metric, often presumed to be the "shortest-path" metric. Other plausible possibilities for intrinsic graph metrics are formulated in terms of the (combinatorial) Laplacian matrix of the graph, as well as in terms of other combinatoric, probabilistic, and physical frameworks. The physically motivated candidates are developed in terms of electrical resistances and wave-amplitude correlations. Some theorems concerning the consequent candidate metrics are noted. Granted an intrinsic metric, there are consequent graph invariants. Two natural "graph cyclicity" invariants to measuring the degree of cyclicity of a graph are noted, along with some associated theorems. Further invariants may be defined through analogy to quantities defined for Euclidean geometries. Such include: linear curvature, torsion, Gaussian curvature, and a sequence of volumina measures. One might surmise that there arises the possibility of some sort of "graph geometry".

Contributed Talks IIIA, Saturday 2:20-3:30pm

2:20-2:40 **Jozsef Balogh**, Ohio State University. Joint with P. Keevash and B. Sudakov.
Title: *Disjoint Representability of sets.*
Abstract: For a hypergraph $\mathcal{H}$ and a set S, the *trace* of $\mathcal{H}$ on S is the set of all intersections of edges of $\mathcal{H}$ with S. We will consider forbidden trace problems, in which we want to find the largest hypergraph $\mathcal{H}$ that does not contain some list of forbidden configurations as traces, possibly with some restriction on the number of vertices or the size of the edges in $\mathcal{H}$. Write $[k]^{(\ell)}$ for the set of all ℓ-subsets of $[k] = \{1, \cdots, k\}$. Note that $\mathcal{A}$ has k *disjointly representable sets* exactly when it has a $[k]^{(1)}$ trace. We will focus on three forbidden configurations: the k-singleton $[k]^{(1)}$, the k-co-singleton $[k]^{(k-1)}$ and the k-chain $\mathcal{C}_k = \{\emptyset, \{1\}, [1, 2], \cdots, [1, k-1]\}$. We prove a number of results on the size of the largest hypergraph $\mathcal{H}$ with some combination of these traces forbidden, sometimes with restrictions on the number of vertices or the size of the edges. We obtain exact results in the case $k = 3$, both for uniform and non-uniform hypergraphs, and classify the extremal examples, and asymptotical results for larger values of k. This is joint work with P. Keevash and B. Sudakov.

2:45-3:05 **Rong Luo**, Middle Tennessee State University.
Title: *Coloring edges of graphs embedded in a surface of characteristic* -3.
Abstract: Consider graphs that are embeddable in a surface of characteristic -3. It is known that class two graphs of this type with maximum degree at most 8 exist. Yan and Zhao showed that such graphs with maximum degree at least 10 must be class one. In this talk, we show that such graphs with maximum degree 9 also must be class one, completing the analysis of these surfaces.

3:10- 3:30 **Nathan Kahl**, Stevens Institute of Technology.
Title: *On the Constructability of Spanning Tree Edge Densities and Edge Dependencies.*
Abstract: The *spanning tree density* of edge e of a graph G is defined to be the fraction of spanning trees of G which contain e, and the *dependency* of G is defined to be the maximum density over all edges of G. Ferrara, et al., asked if all rational densities and dependencies on the interval $(0, 1]$ were constructible via either a simple graph or proper mulitgraph. In this talk we provide constructions that answer the density question in the affirmative for both simple graphs and proper multigraphs, and answer the dependency question for proper multigraphs in the affirmative as well. We also show that two series-parallel properties of these particular constructions generalize to all graphs, and use these properties to show that all dependencies on $[\frac{1}{2}, 1]$ are constructible via simple graphs.

Contributed Talks IIIB, Saturday 2:20-3:30pm

2:20- 2:40 **Arthur Hobbs**, Texas A&M University. Joint with James Oxley.
Title: *William T. Tutte.*
Abstract: In preparing for a memorial paper on William T. Tutte (AMS Notices, March, 2004), James Oxley and I found answers to many questions about Tutte's life and work which we could not include in our article. In this talk, I will present some of what we learned.

2:45- 3:05 **Kenneth K. Nwabueze**, University of Brunei.
Title: *The Combinatorial properties of some number theoretic functions.*
Abstract: A function F that maps the set of positive integers into an integral domain or a field is called a number theoretics function. This talk exhibits some combinatorial properties of certain representations of F.

3:10- 3:30 **Vladimir D. Tonchev**, Michigan Technological University. Joint with Masaaki Harada and Clement Lam.
Title: *Symmetric nets and generalized Hadamard matrices over groups of order 4.*
Abstract: This talk is based on joint work with Masaaki Harada and Clement Lam [1]. The symmetric class-regular $(4, 4)$-nets having a group of bitranslations G of order four are enumerated up to isomorphism. There are 226 nets with $G \simeq Z_2 \times Z_2$, and 13 nets with $G \simeq Z_4$. Using a $(4, 4)$-net with full automorphism group of smallest order, the lower bound on the number of pairwise non-isomorphic affine 2-$(64, 16, 5)$ designs is improved to 21,621,600. The classification of class-regular $(4, 4)$-nets implies the classification of all generalized Hadamard matrices (or difference matrices) of order 16 over a group of order four up to monomial equivalence. The binary linear codes spanned by the incidence matrices of the nets, as well as the quaternary and Z_4-codes spanned by the generalized Hadamard matrices are computed and classified. The binary codes include the affine geometry $[64, 16, 16]$ code spanned by the planes in $AG(3, 4)$ and two other inequivalent codes with the same weight distribution. These codes support non-isomorphic affine 2-$(64, 16, 5)$ designs that have the same 2-rank as the classical affine design in $AG(3, 4)$, hence provide counter-examples to Hamada's conjecture. Many of the F_4-codes spanned by generalized Hadamard matrices are self-orthogonal with respect to the Hermitian inner product and yield quantum error-correcting codes, including some codes with optimal parameters. Research supported by NSF Grant CCR-0310832 and NSA Grant MDA904-03-1-0088.
`tonchev@mtu.edu`, `www.math.mtu.edu/~tonchev`.

[1] M. Harada, C. Lam and V. D. Tonchev, Symmetric $(4, 4)$-nets and generalized Hadamard matrices over groups of order 4, *Designs, Codes and Cryptography* (to appear).

Contributed Talks IVA, Saturday 3:55-5:30pm

3:55-4:15 **Brent Hamilton**, Texas State University. Joint with Daniela Ferrero.
Title: *Eccentric Sequences in Trees.*
Abstract: Given an eccentric sequence, we construct nonisomorphic trees with the given sequence. We present some properties of eccentric sequences in trees. Joint work with D. Ferrero.

4:20-4:40 **Zoran Sunik**, Texas A&M University.
Title: *Bandwith and bandwidth reduction.*
Abstract: The bandwidth reduction number of a graph is defined as the smallest number of edges that need to be deleted from the graph in order to obtain a graph of striclty smaller bandwidth. We discuss the bandwith and bandwith reduction number of rectangular grids and related graphs.

4:45-5:05 **Tomislav Doslic**, Texas A&M University at Galveston.
Title: *Calculus-based approach to log-convexity.*
Abstract: We present a new, calculus-based method of establishing logarithimc convexity or logarithmic concavity of sequences of positive real numbers, and demonstrate its application on some sequences of combinatorial interest.

5:10-5:30 **Louis Petingi**, College of Staten Island, City University of New York.
Title: *A Generalization of the Source-to-all-terminal Network Reliability Domination.*
Abstract: Let $G = (V, E)$ be a digraph with a distinguished set of terminal vertices K and a vertex s of K. We define the s, K-diameter of G as the maximum distance between s and any of vertices of K. If the arcs fail randomly and independently with known probabilities (vertices are always operational), the Diameter-constrained s, K-terminal reliability of G, $R(s, K, G, D)$, is defined as the probability that surviving arcs span a subgraph of G, whose s, K-diameter does not exceed a given bound D, $0 < D < |V|$.
This measure represents a generalization of the classical reliability $R(s, K, G)$ (also known as the source-to-K-terminal reliability) as $R(s, K, G)$ is equal to $R(s, K, G, D)$ for $D = |V| - 1$ (i.e. unconstrained finite diameter). A graph invariant called the domination of a graph G was introduced by Satyanarayana and Prabhakar, to generate the non-canceling terms of the classical reliability, in order to efficiently evaluate $R(s, K, G)$.
In this talk we give a characterization of the diameter-constrained s, K-terminal reliability domination of a digraph $G = (V, E)$ with terminal set $K = V$ (source-to-all-terminal diameter-constrained reliability), for any diameter bound D. Moreover we use these combinatorial results to present an algorithm for the evaluation of $R(s, V, G, D)$.

Contributed Talks IVB, Saturday 3:55-5:30pm

3:55-4:15 **Kathryn Nyman**, Texas A&M University. Joint with Ed Swartz.
Title: *On the h and flag h-vectors of geometric lattices.*
Abstract: Geometric lattices arise out of the structure of arrangements of points in space. Two enumerative invariants associated to geometric lattices are the h- and flag h-vectors. The discovery of a "convex ear" decomposition for geometric lattices prompted a look into the inequalities satisfied by these vectors. Resulting information on the flag h-vector translates into information about zonotopes associated to oriented matroids, and the flag h-vectors of spherical buildings.

4:20-
4:40

Vadim Ponomarenko, Trinity University.
Title: *Minimal Zero Sequences in* $\mathbb{Z}/n\mathbb{Z}$.
Abstract: A zero sequence is an unordered collection of elements (repetition permitted) whose sum is zero. Minimal (with respect to inclusion) zero sequences of finite abelian groups have been the subject of considerable recent study. This talk presents some recent results for finite abelian groups of rank one.

4:45-
5:05

Terri Moore, University of Washington. Joint with John Palmieri.
Title: *Counting Minimal Zero-sequences of a Finite Abelian Group.*
Abstract: Let $G = \mathbb{Z}_{n_1} \oplus \mathbb{Z}_{n_2} \cdots \mathbb{Z}_{n_k}$ be a finite abelian group. A minimal zero-sequence of G is a sequence of (not necessarily distinct) elements of G which sum to zero in G with the added property that no proper subsequence of G also sums to zero. Let $m_n(G)$ be the number of minimal zero-sequences of G with n elements. We seek to find the general form of $m_n(G)$. Toward this aim, we have formulas for $m_2(G)$ and $m_3(G)$ for any G, $m_n(G)$ for any n and $G = (\mathbb{Z}_2)^k$, and $m_4(G)$ for $G = (\mathbb{Z}_2)^k \oplus \mathbb{Z}_6$, $\mathbb{Z}_p$ p prime, and $\mathbb{Z}_{2^k}$. I will present the formulas and some of the approaches taken to arrive at them. Joint work with Dr. John Palmieri.

5:10-
5:30

Barbara Anne McClain, Trinity University.
Title: *Factorization in the Ring of Integer-Valued Polynomials.*
Abstract: The Ring of Integer-Valued Polynomials (denoted $\text{Int}(\mathbb{Z})$) does not constitute a unique factorization domain, and so factorization problems in this ring are particularly appealing. We present a criterion for irreducibility in $\text{Int}(\mathbb{Z})$, several results concerning factorization lengths, and a class of polynomials that factor uniquely.

Contributed Poster Session, Friday 3:35-4:10pm and Saturday, 10:20-10:40am

Ivette Arambula, Texas A&M University.
Title: *Restricted b-factors in bipartite graphs and combinatorial t-designs.*
Abstract: We present a new equivalence result between restricted b-factors in bipartite graphs and combinatorial t-designs. This result is useful in the construction of t-designs by polyhedral methods. We propose a novel linear integer programming formulation, which we call GDP, for the problem of finding t-designs and analyze some polyhedral properties of it. We also implement a branch-and-cut algorithm using GDP, and solve several instances of small designs to compare with other approaches found in the literature.