Langenhop Lecture and SIU Pure Mathematics Conference

Department of Mathematics
Southern Illinois University Carbondale
Carbondale, Illinois, USA

May 14–15, 2019

Combinatorics participants

Mark Ellingham (Vanderbilt University)

Dinush Jayasooriya Panditharathna (Southern Illinois University)

Alicia Marino (Hartford University)

John McSorley (Southern Illinois University)

Andrew Schwartz (Southeast Missouri State University)

Haohao Wang(Southeast Missouri State University)

Tuesday, May 14, 2019

Kwangho Choiy(Chair)

Algebra & Number Theory	**Neckers 240**
David Leep	8:50-9:35
Lisa Kaylor	9:40-10:00
Ralf Schmidt	10:05-10:50
Rodney L. Keaton	10:55-11:15
Dylon Chow	11:20-11:40

Dubravka Ban(Chair)

Algebra & Number Theory	**Neckers 240**
Shuichiro Takeda	1:00-1:45
Daniel Shankman	1:50-2:10
Wai Kiu Chan	2:15-3:00
Lenny Fukshansky	3:05-3:25
Ravindra Girivaru	3:30-3:50

Jerzy Kocik(Chair)

Combinatorics & Geometry	**Nckers 440**
Shoichi Fujimori	9:00-9:45
Charles Delman	9:50-10:35
Louis Kauffman	10:40-11:25

Jerzy Kocik(Chair)

Combinatorics & Geometry	**Nckers 440**
Indu Satija	1:00-1:45
Zbigniew Oziewicz	1:50-2:35
Bill Page	2:40-3:10
Robert Owczarek	3:15-3:45

Wesley Calvert(Chair)

Logic	**Nckers 440**
Henry Townsner	9:00-9:20
Gabriel Conant	9:30-9:50
Alexi Block Gorma	10:00-10:20
Carl Mummert	10:30-10:50
Oscar Levin	11:00-11:20

Wesley Calvert(Chair)

Logic	**Nckers 440**
James Freitag	1:00-1:25
Simon Cho	1:30-1:50
Rose Weisshaar	2:00-2:20
Ivan Ongay Valverde	2:30-2:50
Nadja Hempel	3:00-3:20

(1) Registration on Monday begins at 8:00 at the atrium of Neckers, followed by a welcome session 8:30-8:45 in Neckers Room 240.
(2) The Langenhop Lecture is in Guyon Auditorium of Morris Library.
(3) The lunch is 11:30-1:00 pm.

Tuesday, May 15, 2019

Andrew Earnest(Chair)

Algebra & Number Theory	Neckers 240
Anna Haensch	8:30-8:50
Lakshika Gunawardana	8:55-9:15
Yeongseong Jo	9:20-9:40
Chathurika Athapattu	9:45-10:05
Bogdan Petrenko	10:10-10:55
Benjamin Hutz	11:00-11:20
Jireh Loreaux	11:25-11:45

Kwangho Choy(Chair)

Algebra & Number Theory	Neckers 240
Haohao Wang	1:30-2:00
Henri Shurz	2:00-2:30

Jerzy Kocik(Chair)

Combinatorics & Geometry	Nckers 440
Mark Ellingham	9:00-10:00
Dinush Panditharathna	10:00-10:30
Coffee Break	10:30-11:00
John McSorley	11:00-11:30

Jerzy Kocik(Chair)

Combinatorics & Geometry	Nckers 440
Indu Satija	1:00-1:45
Zbigniew Oziewicz	1:50-2:35
Bill Page	2:40-3:10
Robert Owczarek	3:15-3:45

Wesley Calvert(Chair)

Logic	Nckers 156
Philipp Hieronymi	8:30-8:50
Rachael Alvir	9:30-9:50
Michael Cotton	10:00-10:20
Wim Ruitenburg	10:30-10:50
Tyler Brown	11:00-11:20
Valentina Harizanov	

Wesley Calvert(Chair)

Logic	Nckers 156
Damir Dzhafarov	1:00-1:20
Hunter Chase	1:30-1:50
Rumen Dimitrov	2:00-2:20
Gihanee Senadheera	2:30-2:50

Combinatorics Abstract

The Even Map Color Theorem

Mark Ellingham
Department of Mathematics
Vanderbilt University

Most people are familiar with the Four Color Theorem, which says that the faces of a planar map may be colored in four colors so that adjacent faces receive different colors. A dual version says that the chromatic number (the number of colors needed to color the vertices so that adjacent vertices receive different colors) of a planar graph is at most four. The Map Color Theorem generalizes the Four Color Theorem to arbitrary surfaces by bounding the chromatic number of a graph embeddable in a given surface. In 1976 Joan Hutchinson showed that the bound of the Map Color Theorem can be significantly improved for graphs embeddable with all faces having even degree. Recently we showed that Hutchinson's bound is sharp in most cases. We therefore now have an Even Map Color Theorem. The sharpness examples are found using quadrangular (or nearly quadrangular) embeddings of complete graphs. We discuss several techniques that can be used to construct these embeddings.

This is joint work with Beifang Chen, Nora Hartsfield, Serge Lawrencenko, Wenzhong Liu, Hui Yang, Dong Ye and Xiaoya Zha.

Spanning Trees of Certain Types

John McSorley and Dinush Jayasooriya
Department of Mathematics
Southern Illinois University Carbondale

A spanning tree of a graph G is a subgraph that is a tree which includes all of the vertices of G. And a graph G is bipartite if the vertex set of G can be partitioned in to two sets A and B, such that every edge of G joins a vertex of A and a vertex of B. We can see that every tree(including spanning tree) is bipartite. We define type of a spanning tree using this idea as follows: We divide vertices of spanning trees in to two partitions A and B by using its bipartition. Then, we define type of the spanning tree by $(\mid A \mid, \mid B \mid)$, provided $\mid A \mid \leq \mid B \mid$. We first identify the characteristics for a graph to have a spanning trees of certain types. Then, implement some theorems about the type.

Deep holes and the moment k-subset sum problem

Alicia Marino
Mathematics Department
University of Hartford

Deep holes of Reed-Solomon codes are words that are maximally far from codewords. Identifying deep holes is intimately linked to a version of the well-known subset sum problem. We wish to give specific conditions on when a generalization of the k-subset sum problem, called the moment k-subset sum problem, is solvable over certain subsets $D \subseteq \mathbb{F}_q$ and in this talk will discuss partial results in this direction. This is joint work with Angela Robinson, Tim Lai, and Daqing Wan.

Sequential Covering Designs

John P. McSorley,
Department of Mathematics,
SIUC.

In 1995 Wal Wallis discovered/invented the notion of looking at a classical design as a sequence, thus discovering/inventing a *sequential covering design*.

Sequence A of length t based on v-set V is a *sequential covering design*, SCD, if *every* pair $\{x, y\}$ $(x \neq y)$ from V is covered by A, *i.e.*, is contained within some k-block of A. We denote such an A by $SCD(v, k, t)$.

For a fixed v and $k \geq 2$ we define $g(v, k)$ to be the smallest t for which a $SCD(v, k, t)$ exists, and call a $SCD(v, k, g(v, k))$ *minimal*, and *non-minimal* otherwise.

In this talk we extend some results of Wallis and carry on with further research into SCD. We present new constructions, a greedy algorithm, and connections with other combinatorial objects, such as Steiner Triple Systems. Many examples will be given, we mainly concentrate on $k = 3$.

Zero Forcing Sets in H-matchable graphs

Andrew Schwartz
Department of Mathematics
Southeast Missouri State University

In this talk, a graph $G = (V(G), E(G))$ has no isolated vertices and is finite, simple, and undirected. Fix a non-trivial connected graph H. A *perfect H-matching* of a graph G is a set $\{H_1, ..., H_n\}$ of vertex-induced subgraphs of G (i.e., all $G[V(H_i)] = H_i$) where $\{V(H_1), ..., V(H_n)\}$ partitions $V(G)$ and each subgraph $H_i \cong H$. Two perfect H-matchings of G are *equal* iff they are equal as sets of graphs. A perfect matching of G is then a perfect P_2-matching of G. We say that G is *H-matchable* (*matchable*) iff G has a perfect H-matching (perfect matching). The zero forcing number of a simple graph was introduced by the "AIM Minimum Rank-Special Graphs Work Group" to bound the minimum rank for numerous families of graphs. Zero forcing parameters has been investigated further and has been applied to the minimum rank problem in much recent literature. We will explore the possibilities for a zero forcing number of a H-matchable graph.

Abstract for LLMC on Structure of Minimal Free Resolutions for Quaternion Rational Surfaces

Haohao Wang
Department of Mathematics
Southeast Missouri State University

A quaternion rational surface is a rational surface generated by two rational space curves via quaternion multiplication. In general, the structure of the graded minimal free resolution of a rational surface is unknown. The goal of this presentation is to construct the graded minimal free resolution of a quaternion rational surface generated by two rational space curves. We will provide the explicit formulas for the maps of these graded minimal free resolutions. The approach we take is to utilize the information of the μ-bases of the generating rational curves, and create the generating sets for the first and second syzygy modules in the graded minimal free resolutions. In addition, we show that the ideal generated by the first syzygy module expressed in terms of moving planes is exactly the same as the ideal generated by the parametrization in the affine ring.