Workshop on Combinatorics

Venue | 地点: Shanghai Jiao Tong University
Time | 时间: Nov. 06–08, 2020

Schedule | 日程

Nov. 06, Friday

Zoom Meeting ID :   930 965 36751
Password :   287584
Chair :   Yaokun Wu

13:00 – 13:45   **Characterizations of relativized distal points of topological dynamical systems**
Xiongping Dai | 代雄平 (Nanjing University)

14:00 – 14:45   **Analytic properties of combinatorial sequences**
Baoxuan Zhu | 祝宝宣 (Jiangsu Normal University)

Zoom Meeting ID :   999 200 21577
Password :   375313
Chair :   Xiaodong Zhang

17:05 – 17:55   **Hedetniemi's conjecture and Poljak-Rödl function**
Xuding Zhu | 朱绪鼎 (Zhejiang Normal University)

Nov. 07, Saturday

Zoom Meeting ID :   929 204 55163
Password :   202082
Chair :   Yinfeng Zhu

09:00 – 09:45   **Escape rate of continuous time random walks**
Xueping Huang｜黄学平 (Nanjing University of Information Science & Technology)

10:00 – 10:45   **Functional limit theorems for random biregular bipartite graphs**
Yizhe Zhu｜朱亦哲 (University of California, San Diego)

Zoom Meeting ID :   953 389 51826
Password :   243939
Chair :   Jiyou Li

13:30 – 14:15   **The product version of Erdös-Ko-Rado Theorem**
Huajun Zhang｜张华军 (Zhejiang Normal University)

14:20 – 15:05   **Enumeration of rooted labelled trees and combinatorial identities**
Shaoshi Chen｜陈绍示 (Chinese Academy of Sciences)

15:10 – 15:55   **A character approach to directed genus distribution of graphs: The bipartite single-black-vertex case**
Yichao Chen｜陈仪朝 (SuZhou University of Science and Technology)

Nov. 08, Sunday

Zoom Meeting ID :   940 822 91696
Password :   294199
Chair :   Da Zhao

09:00 – 09:45   **When design theory meets quantum information**
Yan Zhu｜朱艳 (Shanghai University of Science and Technology)

10:00 – 10:45   **Finiteness of tight combinatorial designs**
Ziqing Xiang｜向子卿 (Academia Sinica)

Zoom Meeting ID :   932 257 29991
Password :   740342
Chair :   Jun Ma

13:30 – 14:15   **Regular rational orthogonal matrices, GM-switching and cospectral graphs**
Wei Wang｜王卫 (Xi'an Jiaotong University)

14:25 – 15:10   **A survey talk on phylogenetic networks**
Yangjing Long｜龙旸靖 (Central China Normal University)

Zoom Meeting ID : 932 257 29991
Password : 740342
Chair : Dominik Scheder

15:30 – 16:20 **Enumerating maximal induced subgraphs**
Yixing Cao | 操宜新 (Hong Kong Polytechnic University)

Abstract｜摘要

Enumerating maximal induced subgraphs

Yixin Cao

Given a graph G, the maximal induced subgraphs problem asks to enumerate all maximal induced subgraphs of G that belong to a certain hereditary graph class. After a survey of main results in this area, we introduce our new results. (The paper is available at `https://arxiv.org/abs/2004.09885`.)

Enumeration of rooted labelled trees and combinatorial identities

Shaoshi Chen

Cayley's famous formula n^{n-2} counts the number of labelled trees with n vertices. This formula motivates extensive studies on different types of labelled trees. In this talk, we will present some enumerative results on rooted labelled trees that connect with two interesting binomial identities. Digraph interpretations and matrix representations are given for establishing the equivalence between these two identities.

This is a joint work with Xi Chen and Tomack Gilmore.

A character approach to directed genus distribution of graphs: The bipartite single-black-vertex case

Yichao Chen

Given an Eulerian digraph, we consider the genus distribution of its face-oriented embeddings. We prove that such distribution is log-concave for several families of Eulerian digraphs, thus giving a positive answer for these families to a question asked in Bonnington, Conder and Morton (2002). The proof uses real-rooted polynomials and the representation theory of the symmetric group $\mathbb{S}_n$. The result is also extended to some factorizations of the identity in $\mathbb{S}_n$ that are rotation systems of some families of constellations. (Joint work with Wenjie Fang)

Characterizations of relativized distal points of topological dynamical systems

Xiongping Dai

Let $\pi\colon (T,X) \to (T,Z)$ be an extension of flows with phase group T. An x in X is π-distal if x is at most proximal to itself in $\pi^{-1}\pi(x) \cap \overline{Tx}$ under (T,X). We present characterizations of π-distal points using the product (IP-, C_w-, C-) recurrence, dynamics syndetic sets, distal sets, IP*-sets, and C*-sets in T.

Escape rate of continuous time random walks

Xueping Huang

The classical law of iterated logarithm gives an upper bound for how far a simple random walk can go in large time. For general continuous time random walks on weighted graphs, it is natural to study criteria for analogous long time asymptotics. We summarize different approaches to this problem in the literature, and focus on the tools from the Dirichlet form theory.

A survey talk on phylogenetic networks

Yangjing Long

Phylogenetics is the study of the evolutionary relationships between organisms. One of the main challenges in the field is to take biological data for a group of organisms and to infer an evolutionary tree, a graph that represents these relationships. However, due to hybridization and gene flow, a phylogenetic network may be a better representation of the evolutionary history of some groups of organisms. In this talk, we will give an overview and some recent results on phylogenetic networks.

Regular rational orthogonal matrices, GM-switching and cospectral graphs

Wei Wang

A regular rational orthogonal matrix Q is an orthogonal matrix with rational entries such that $Qe = e$ (e is the all-one vector), which plays a central role in the study of cospectral graphs. A famous method for constructing cospectral graphs proposed by Godsil and McKay in 1982 uses a regular rational orthogonal matrices of a particular type. We try to generalize this approach from various directions. Some results and conjectures will be presented along this line of research.

Finiteness of tight combinatorial designs

Ziqing Xiang

Combinatorial designs are designs on combinatorial spheres, i.e. the Johnson association schemes. Tight combinatorial designs are the ones whose sizes satisfy the Fisher type lower bound. Bannai proved in 1977 that for each large even strength, there are only finitely many tight designs. If we analyze carefully his method, it could be possible to derive an exponential bound on the parameters. In this talk, I will introduce a completely different approach, and use it to give an explicit polynomial bound on the parameters.

The product version of Erdös-Ko-Rado Theorem

Huajun Zhang

Let n and k be two positive integers satisfying $n \geq 2k$. Let $\mathcal{A}$ be an intersecting family of $\binom{[n]}{k}$. The Erdös-Ko-Rado Theorem states that

$$|\mathcal{A}| \leq \binom{n-1}{k-1}$$

and, except for the case of $n = 2k$, the equality holds if and only if there is an element $i \in [n]$ such that $\mathcal{A}$ consists of all subsets of $[n]$ which contains i. There are many generalizations of this theorem. In this talk, we will introduce some problems and results on the product version of this theorem.

Analytic properties of combinatorial sequences

Baoxuan Zhu

In this talk, we will report some developments in analytic properties of combinatorial sequences. These properties include unimodality, log-concavity, log-convexity, Polya Frequency, Stieltjes moment properties, total positivity of matrices, polynomials with only real zeros and continued fractions. They often arise in Combinatorics and Analysis, Algebra and Geometry, Probability and Statistics, and so on.

Hedetniemi's conjecture and Poljak-Rödl function

Xuding Zhu

Hedetniemi conjectured in 1966 that $\chi(G \times H) = \min\{\chi(G), \chi(H)\}$ for all graphs G, H. This conjecture received a lot of attention in the past half century and was eventually refuted by Shitov in 2019. The Poljak-Rödl function is defined as $f(n) = \min\{\chi(G \times H) : \chi(G) = \chi(H) = n\}$. It is obvious that $f(n) \leq n$ for all n, and Hedetniemi's conjecture is equivalent to say that $f(n) = n$ for all integer n. Shitov proved that for very large n (say for $n \geq 3^{90}$), $f(n) < n$. Recently, I improved this to $f(n) < n$ for $n \geq 125$, and very recently, Tardif further improved the result to $f(n) < n$ for $n \geq 14$. On the other hand, the only known lower bound for $f(n)$ is that $f(n) \geq 4$ for $n \geq 4$. This talk discusses about counterexamples to Hedetniemi's conjecture, shows that $f(n) \leq (\frac{1}{2} + o(1))n$ and survey some other work related to Hedetniemi's conjecture.

When design theory meets quantum information

Yan Zhu

The purpose of design theory is to find a good finite subset which approximates the given space. Designs in unitary groups and complex or real spheres are recently attracting much attention in quantum information science. For instance, certain complex spherical 2-designs correspond to equiangular lines or SICs (i.e., symmetric informationally complete) in quantum information theory, and (real) spherical designs are closely related to anticoherent quantum states. In this talk, we will introduce unitary designs and spherical designs as well as the connection with some topics in quantum information.

Functional limit theorems for random biregular bipartite graphs

Yizhe Zhu

A biregular bipartite graph is a bipartite graph where each vertex on the same side has the same degree. It plays an important role in computer science, including sampling, complexity theory, and the design of error-correcting codes.

We consider limit theorems for various combinatorial and spectral properties of uniformly distributed random biregular bipartite graphs with fixed and growing degrees, including the Poisson approximation of the number of cycles and cyclically non-backtracking walks, spectral gaps, limiting spectral distributions, and global eigenvalue fluctuations. As an application, we translate the results to uniformly distributed random regular hypergraphs.

This talk is based on joint work with Ioana Dumitriu.

Participants

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