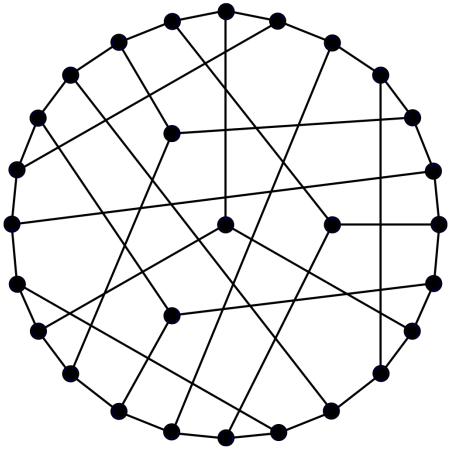
Workshop on Algebraic Graph Theory



Pilsen, October 3-7, 2016

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Workshop on Algebraic Graph Theory, Pilsen, 2016

The workshop is focused on various problems in algebraic graph theory. It is co-organized by the Faculty of Applied Sciences of the University of West Bohemia in Pilsen, by the Institute for Theoretical Computer Science (CE-ITI), and by the Union of Czech Mathematicians and Physicists (JČMF). We would like to acknowledge support by the project No. P202/12/G061 (CE-ITI) of the Czech Science Foundation.

Our aim is to bring together people interested in various aspects of algebraic graph theory. The programme will consist of lectures by invited speakers and of contributed talks related to one or more of the following topics:

- Coherent configurations and association schemes,
- Symmetrical graph embeddings and regular maps,
- Group actions on graphs,
- Computational algebra,
- Other applications of algebra and linear algebra on graphs.

Program committee

Roman Nedela, University of West Bohemia, Pilsen, Czech Republic,

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Štefan Gyürki, Matej Bel University, Banská Bystrica, Slovakia.

Proceedings

We plan to publish reviewed proceedings of the workshop AGT'16. The details, including the deadline for submission of contributions, will be announced during the workshop.

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10:50 – 11:50	**Reinhard Pöschel** Invariance groups of finite functions, orbit equivalence and group actions
12:00 – 13:00	**Qing Xiang** The Smith and Critical Groups of a Graph
13:00 – 15:00	Lunch
15:00 – 15:25	**Alejandra Ramos Rivera** A generalization of Bouwer's graphs
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16:05 – 16:30	**Dipendu Maity** Semi-equivelar maps on the torus
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15:00 – 16:00	**Josef Lauri** Constructive and analytical enumeration of circulant graphs with p^3 vertices, $p = 3, 5$
16:10 – 16:35	**Bart Michael Litjens** New semidefinite bounds for mixed binary/ternary codes
16:40 – 17:05	**Sven Carel Polak** Semidefinite bounds for nonbinary codes based on quadruples
19:00	Conference dinner

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10:30 – 10:50	Coffee break
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12:00 – 13:00	**Mikhail Muzychuk** On non-commutative associations schemes of rank six
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An application of the theory of coherent configurations to the computation of chromatic polynomials

Christian Pech
Dresden University of Technology, Germany

Chromatic polynomials form one of the most important concepts in graph theory because they encode many important properties (the number of proper vertex colorings with x colors, the number of acyclic orientations, etc.)

Computing the chromatic polynomial of graphs is an important algorithmic problem. However, already the problem of deciding whether a given graph has a proper 3-coloring is NP-complete. Hence in general it can not be expected to give ONE algorithm that is going to be efficient for ALL graphs. Instead algorithms are searched for, that are efficient for interesting classes of graphs (polynomial algorithms are known e.g. for complete graphs, trees, cycles, ladders, outer-planar graphs, graphs of graphs of bounded clique-width).

In this talk we will outline an idea to apply the theory of coherent configurations in order to compute the chromatic polynomials of so called generalized ladder graphs. The described method is effective and its running time is linear in the number of rungs of the generalized ladder graph.

The research that lead to the presented method goes back to a visit to Misha Klin in Beer Sheva back in the year 2000. However, it is not widely known and we still consider it to be a striking and instructive illustration of the possible uses of coherent configurations in algebraic graph theory.

Invariance groups of finite functions, orbit equivalence and group actions

Reinhard Pöschel
Dresden University of Technology, Germany

The *invariance group* of an n-ary Boolean function $f : \{0,1\}^n \to \{0,1\}$ is the subgroup of the full symmetric group S_n consisting of all permutations $\sigma : i \mapsto i^\sigma$ which satisfy $f(x_{1^\sigma}, \ldots, x_{n^\sigma}) = f(x_1, \ldots, x_n)$ for all $x_1, \ldots, x_n \in \{0,1\}$. In the talk such invariance groups and several generalizations (to other group actions as well as to other than Boolean functions) are considered and (partially) characterized. Moreover, they are Galois closures of a suitable Galois correspondence and connections to the orbit equivalence closure as well as to Wielandt's k-closure are considered.

The Smith and Critical Groups of a Graph

Qing Xiang
University of Delaware, Newark, Delaware, USA

Let G be a finite graph and A its adjacency matrix. The Laplacian matrix of G is defined by $L := D - A$, where D is the diagonal matrix of degrees. Associated with G are two abelian groups. The first is the Smith group $S(G)$ and the second the critical group $K(G)$. We will talk about these groups, with emphasis on the critical group. In particular, we will discuss the recent computations of the Smith and critical group of the Paley graph (in joint work with David Chandler and Peter Sin) using representation theory and number theory.

A generalization of Bouwer's graphs

Alejandra Ramos Rivera
Andrej Marušič Institute, University of Primorska, Koper, Slovenia

Bouwer proved that there exists a half-arc-transitive graph of every even valency greater that 2, by giving a contruction for a family of graphs now known as $\mathcal{B}(k, m, n)$. Recently, it was proved by M. Conder and A. Žitnik which of Bouwer's graphs are half-arc-transitive.

Let $D_G(X)$ be one of the two oppositely oriented digraphs associated with a half-arc-transitive graph X with respect to the action of $Aut(X)$. Two arcs are related if they have the same intial vertex (*tail*), or the same terminal vertex (*head*). The subgraphs consisting of equivalence classes of directed edges of this relation are called *alternets*.

Let $\mathcal{A} = \{A_i | i \in \{1, 2, \ldots, m\}\}$ be the set of alternets in X and for each $i \in \{1, 2, \ldots, m\}$ define H_i to be the set of all vertices at the heads of arcs in $A_i \in \mathcal{A}$, and T_i be the set of all vertices at the tail of arcs in A_i. If $H_i = T_j$ for some $i, j \in \{1, 2, \ldots, m\}$, then X is said to be *tightly attached*. Tightly attached graphs with valency 4 were classified by P. Šparl and D. Marušič.

In this talk a family of tightly attached half-transitive graphs with valency $2k$ is introduced as a generalization of the Bouwer's graphs.

Based on joint work with Primož Šparl.

Automorphism Groups of Planar Graphs

Peter Zeman
Charles University, Prague, Czech Republic

In 1975, Babai characterized which abstract groups can be realized as the automorphism groups of planar graphs. In this paper, we give a more detailed and understandable description of these groups. We describe stabilizers of

vertices in connected planar graphs as the class of groups closed under the direct product and semidirect products with symmetric, dihedral and cyclic groups. The automorphism group of a connected planar graph is then obtained as a semidirect product of a direct product of these stabilizers with a spherical group. Our approach translates into a quadratic-time algorithm for computing the automorphism group of a planar graph which is the first such algorithm described in details.

Semi-equivelar maps on the torus

Dipendu Maity
Department of Mathematics, Indian Institute of Science, Bangalore, India

A map is a graph together with an embedding on a surface. A map is a semi-equivelar map if each vertex has the same degree and the cyclic list associated with each vertex is the same (up to inversion of the cyclic order). A weakly regular map is a map on a closed surface on which the automorphism group acts vertex-transitively. Clearly, a weakly regular map is semi-equivelar.

There are eleven types of semi-equivelar maps on the torus. Three of these are eqivelar maps and the remaining are semi-equivelar maps. The classification of these three equivelar maps on the torus are know. We have devised a way (computational steps) of enumerating all eight types of semi-equivelar maps on the torus.

It is known that all the three types of eqivelar maps are vertex-transitive and out of eight types two types of semi-equivelar map are also vertex-transitive on the torus. We have shown that there are infinitely many semi-equivelar maps of the remaining six types on the torus which are not vertex-transitive.

CI-groups for Cayley maps

Gábor Somlai
Eötvös Loránd University, Budapest, Hungary

Cayley maps are 2-cell embeddings of Cayley graphs into orientable surfaces with the extra property that the vertices have the same cyclic orientation at each vertex. A Cayley map can also be considered as a Cayley ternary relational structure.

The Cayley isomorphism (CI) property is well studied for graphs (binary relation) and an old theorem of Pálfy says that in order to describe CI-groups for any n-ary relational structures for every $n \in \mathbb{Z}$ we may assume $n \leq 4$.

The Cayley isomorphism problem for ternary relational structures was investigated by Dobson and Spiga and they give an almost complete list of CI-groups for ternary relational structures. They proved that the class of

CI-groups with respect to ternary relational structures is narrow. We present a similar partial solution for CI-groups with respect to (not necessarily connected) Cayley maps.

Joint work with Mikhail Muzychuk.

Characterizations of graphs by their generalized spectrum

Willem Haemers
Tilburg University, Netherlands

The generalized spectrum of a graph consists of the adjacency spectrum together with the adjacency spectrum of the complement. The talk will survey some recent results concerning the generalized spectrum. This includes (1) developments towards a possible proof that almost all graph are determined by the generalized spectrum, and (2) results on Godsil-McKay switching sets for the construction of nonisomorphic graphs which are cospectral with respect to the generalized spectrum.

On Structural Properties of Generalized Cayley Graphs

Klavdija Kutnar
University of Primorska, Koper, Slovenia

The concept of generalized Cayley graphs was introduced by Marušič, Scapellato and Salvi in [Discrete Math. 102 (1992), 279-285]. In this talk we will present recent results about structural properties of generalized Cayley graphs.

This is joint work with Ademir Hujdurović, Dragan Marušič, Paweł Petecki and Anastasiya Tanana.

On the full automorphism group in symmetric graphs

Dragan Marušič
University of Primorska, Koper, Slovenia

One of the crucial questions in symmetries of graphs is as follows. Given a (vertex-transitive, edge-transitive, symmetric, ...) graph X admitting a transitive action of a group H, determine whether H is the full automorphism group of the graph X. We will give an overview of the various results relative to the above problem.

Construction of directed strongly regular graphs using homogeneous equitable partitions

Štefan Gyürki
Matej Bel University, Banská Bystrica, Slovakia

A directed strongly regular graph (DSRG) with parameters (n, k, t, λ, μ) is a regular directed graph on n vertices with valency k such that every vertex is incident to t undirected edges; the number of directed paths of length 2 directed from any vertex x to another vertex y is λ if there is a dart from x to y, and μ otherwise.

In this talk we introduce a construction, which is producing bigger DSRGs from smaller one if there exists a suitable homogeneous equitable partition in the smaller graph. We also investigate its possible connections to known approaches and ideas for similar constructions used in algebraic graph theory.

r-regular families of graph automorphisms

Róbert Jajcay
University of Primorska, Koper, Slovenia
Comenius University, Bratislava,Slovakia

An r-regular family $\mathcal{F}$ of permutations on a set V contains for each pair of vertices $u, v \in V$ exactly r permutations $\varphi \in \mathcal{F}$ mapping u to v, $\varphi(u) = v$. Previously, 1-regular families of graph automorphisms were used by Gauyacq to characterize the quasi-Cayley graphs; a class of vertex-transitive graphs that properly contains the class of Cayley graphs, shares many characteristics of the Cayley graphs, and is properly contained in the class of vertex-transitive graphs.

We introduce the concept of r-regular families to cover all vertex-transitive graphs, and to serve as a measurement of how far a vertex-transitive graph is from being Cayley. As any automorphism group of a graph $\Gamma = (V, E)$ acting transitively on V with a vertex-stabilizer of order r can be easily seen to form an r-regular family on V, every vertex-transitive graph admits an r-regular family of automorphisms for some $r \geq 1$.

This is a joint project with Gareth A. Jones.

On Siamese Association Schemes

Martin Mačaj
Comenius University, Bratislava, Slovakia

It is known that after removing a spread from a strongly regular graph (srg) $\Gamma = SRG(q^3+q^2+q+1, q^2+q, q-1, q+1)$ we obtain a q^2-valent distance regular graph (drg). Therefore there is a possibility for an edge-decomposition of the

complete graph on q^3+q^2+q+1 vertices into a spread and $q+1$ drgs such that each drg together with the spread gives a $SRG(q^3+q^2+q+1, q^2+q, q-1, q+1)$. Any such decomposition will be called Siamese color graph on q^3+q^2+q+1 vertices. If there exists an association scheme W which contains all the drgs of a Siamese color graph as basic graphs we say that W is a Siamese association scheme (note that in this case the spread is a union of the remaining basic graphs of W).

In this paper we study properties of Siamese association schemes. Our main result is the following generalization of the construction by H. Kharaghani and R. Torabi.

Expanding the results of P. Gibbons and R. Mathon (1987) and H. Kharaghani and R. Torabi (2003) we show that any affine plane of order q together with any abelian group of order $q+1$ give rise to several Siamese association schemes on q^3+q^2+q+1 points. We also present the results of an exhaustive search for all schemes of this type for $q \leq 11$.

This talk is based on a joint project with M. Klin, S. Reichard and A. Woldar.

Restrictions on classical distance-regular graphs

Aleksandar Jurišić
Faculty of Computer and Information Science, University of Ljubljana

Let Γ be a distance-regular graph of diameter $d \geq 2$. It is said to have *classical parameters* (d, b, α, β) when its intersection array $\{b_0, b_1, \ldots, b_{d-1}; c_1, c_2, \ldots, c_d\}$ satisfies $b_i = ([d]-[i])(\beta-\alpha[i])$ and $c_{i+1} = [i+1](1+\alpha[i])$ $(0 \leq i \leq d-1)$, where $[i] := 1+b+\cdots+b^{i-1}$. Beside the well-known families, there are many sets of classical parameters for which the existence of a corresponding graph is still open. It turns out that in most such cases we have either $\alpha = b-1$ or $\alpha = b$. For these two cases we derive bounds on the parameter β, which give us complete classifications when $b = -2$.

Distance-regular graphs with classical parameters are antipodal iff $b = 1$ and $\beta = 1+\alpha[d-1]$. If we drop the condition $b = 1$, it turns out that one obtains either bipartite or tight graphs. For the latter graphs, we find closed formulas for the parameters of the CAB partitions and the distance partition corresponding to an edge. Finally, we find a two-parameter family of feasible intersection arrays for tight distance-regular graphs with classical parameters $(d, b, b-1, b^{d-1})$, primitive iff $b \neq 1$, and apply our results to show that it is realized only by d-cubes $(b = 1)$.

Keywords: algebraic combinatorics, distance-regular graphs, classical parameters, locally strongly regular, formally self-dual, tight graphs

Quantum Problems

Chris Godsil
University Waterloo, Canada

Quantum information theory is a very rapidly developing area, and one surprising fact is that it has given rise to a number of interesting questions in algebraic combinatorics. My talk will provide an overview of some of what we know about these problems, and the many questions that remain to be solved.

Tatra schemes and their mergings

Sven Reichard
Dresden University of Technology, Germany

We look at a class of schurian association schemes W based on a construction by Mathon [5]. These schemes contain a thin closed set; their thick relations are distance regular covers of complete graphs. These schemes and some of their mergings have been called "Tatra schemes".

The closed set represents a regular cyclic group C. Any S-ring $\mathcal{A}$ of rank d over C can be extended to a merging $W_{\mathcal{A}}$ of W; it has rank $2d$ and is commutative if and only if $\mathcal{A}$ is symmetric.

It is known that association schemes of rank less than 6 are commutative. Hanaki and Zieschang [2] investigated imprimitive non-commutative schemes of rank 6. Recently Herman, Muzychuk and Xu [3] considered this problem on the level of table algebras. If $\mathcal{A}$ is antisymmetric of rank 3, then $W_{\mathcal{A}}$ is an example of such a scheme. This generalizes a construction by Drabkin and French [1].

Keywords: association scheme, distance regular cover, generalized weighing matrices.

References

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[2] Akihide Hanaki and Paul-Hermann Zieschang. *On imprimitive non-commutative association schemes of rank 6.* Communications in Algebra 42: 1151–1199 (2014).

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[4] H. Kharaghani and R. Torabi. *On a decomposition of complete graphs.* Graphs Combin. 19: 519–526 (2003).

[5] Rudolf Mathon *Lower bounds for Ramsey numbers and association schemes.* JCTB 42: 122–127 (1987).

Search for systems of linked symmetric $2-(36,15,6)$ designs

Matan Ziv-Av
Ben-Gurion University of the Negev, Beer-Sheva, Israel

A symmetric (2-)design with parameters (v,k,λ) is an incidence structure (P,B) with v points and v blocks such that each block is incident to k points and each pair of points is incident to λ blocks.

A system of f linked symmetric (v,k,λ) designs is $(B_1,\ldots,B_f)$ such that each B_i is a set of v k-subsets of $[1,v]$, where each pair (B_i,B_j) is a symmetric design with parameters (v,k,λ), and the size of the intersection of sets $C\in B_i$, $D\in B_j$ has one of two values depending on whether they are incident.

Systems of f linked designs can also be defined in terms of association schemes of rank 4 and order fv.

Systems of linked designs were introduced by P. Cameron for studying 2-transitive permutation groups. The known systems of linked designs (for $f\geq 3$) are all with $v=4^m$ points. There is an infinite family of symplectic designs constructed from quadratic forms over $GF(2)$, and a few sporadic examples over biplanes of order 4 (designs with parameters $(16,6,2)$).

The smallest feasible set for linked symmetric designs of order not power of 4 is $(36,15,6)$. The search for symmetric designs with those parameters, as well as for systems of linked symmetric designs will be discussed in detail. In particular, we will start from well-known results by T.Spence about $2-(36,15,6)$ designs, as well as further attempts by D. Crnković.

All those designs were combined into one list, containing one representative for each known design. Basing on this and using extensive computer search, some new negative results about existence of systems of linked designs were obtained.

Automorphism groups of edge-transitive maps

Gareth A. Jones
University of Southampton, United Kingdom

For each of the 14 classes of edge-transitive maps described by Graver and Watkins, necessary and sufficient conditions are given for a group to be the automorphism group of a map, or of an orientable map without boundary, in that class. Extending earlier results of Širáň, Tucker and Watkins, these are used to determine which symmetric groups S_n can arise in this way for each class. Similar results are obtained for all finite simple groups, building on work of Leemans and Liebeck, Nuzhin and others on generating sets for such groups. It is also shown that each edge-transitive class realises finite groups

of every sufficiently large nilpotence class or derived length, and also realises uncountably many non-isomorphic infinite groups.

Regular maps with a given automorphism group, and on a given surface

Jozef Širáň
Open University, Milton Keynes, United Kingdom
Slovak University of Technology, Bratislava, Slovakia

A map is a cellular embedding of a connected graph on a surface. A flag of a map is a vertex-edge-side triple of mutually incident elements. An automorphism of a map is an incidence-preserving permutation of flags, and the automorphism group of a map is known to be a semi-regular permutation group on the set of flags. The extreme case of a map with a 'highest level of symmetry' arises if this permutation group is regular, in which case the map is also called regular. A weaker concept is the one of an orientably-regular map on an orientable surface, in which the group of all orientation-preserving automorphisms is regular on vertex-edge incident pairs.

The theory of regular and orientably regular maps is rich and has fascinating connections with Riemann surfaces and Galois theory. Advances in construction and classification of regular maps may therefore have applications in other branches of mathematics.

In the lecture we will survey the state-of-the-art in the problems of classification of regular maps with a given automorphism group, and regular maps on a given surface. We will also present new results and outline open questions in the two areas of research.

Triangulations of manifolds: Algebraic and combinatorial approaches

Sonia Balagopalan
Institute of Mathematics, Hebrew University of Jerusalem, Israel

A triangulation of a compact manifold M is a simplicial complex whose geometric realization is homeomorphic to M. A natural question given such an M is, what is the smallest number of vertices on which a triangulation of M can be constructed? Very little is known about this problem in general, or even that of the existence of small triangulations for many well known manifolds. On the other hand, known answers for specific manifolds show remarkable properties of symmetry, and connections to various quintessential objects in algebraic graph theory. A well known example is the 7-vertex triangulation of the 2-dimensional torus, which can be obtained as the dual of an embedding of the Heawood graph on the torus. Triangulations of "manifolds like a projective

plane" also have combinatorial properties related to graphs and association schemes of interest to the algebraic graph theorist.

In this talk we focus on one family of manifolds, real projective spaces. The vertex-minimal triangulation problem is open for this class of objects. We will survey the known results on this problem, and point out their rich connections with algebraic graph theory. In particular, we explore the relationship between the known examples and constructions of equiangular lines in euclidean space, and similar objects. We hope that researchers in this area will be motivated to lend their expertise to this and related problems in combinatorial topology.

Constructive and analytical enumeration of circulant graphs with p^3 vertices $p = 3, 5$

Josef Lauri
University of Malta

Two methods, structural (constructive) and multiplier (analytical), of exact enumeration of undirected and directed circulant graphs of orders 27 and 125 are elaborated and represented in detail to1gether with intermediate and final numerical data. The first method is based on the known classification of circulant graphs in terms of S-rings and results in exhaustive listing (with the use of COCO and GAP) of all corresponding S-rings of the indicated orders. The second method is conducted in the framework of a general approach developed earlier for counting circulant graphs of prime-power orders. This approach is based on a known isomorphism criterion for circulant graphs of such orders and on its subsequent adaptation to the enumeration in the Redfield–Pólya style. In particular, five intermediate enumeration subproblems arise, which are refined further into eleven subproblems of this type. These problems are solved for the four cases under consideration (again with the use of GAP): $n = 27; n = 125$, directed and undirected.

Except for the case of undirected circulant graphs of orders 27, the numerical results obtained here are new. In particular the number (up to isomorphism) of directed circulant graphs of orders 27 is shown to be equal to 3,728,891.

Some curious and rather unexpected identities are established between intermediate valency-specified gnerating functions (both for undirected and directed circulant graphs) and their validity is conjectured for arbitrary odd prime p. Two of them are similar to two new identities for prime-squared circulant graphs of which we have proofs.

In general this research can be considered as a crucial initial input towards the explicit uniform enumeration formulae for circulant graphs of orders p^3 for arbitrary prime $p > 2$.

This is joint research with Victoria Gatt, Mikhail Klin and Valery Liskovets.

New semidefinite bounds for mixed binary/ternary codes

Bart Michael Litjens
University of Amsterdam, Netherlands

For nonnegative integers n_2, n_3 and d, let $N(n_2, n_3, d)$ denote the maximum cardinality of a code of length $n_2 + n_3$, with n_2 binary coordinates and n_3 ternary coordinates (in this order) and with minimum Hamming distance at least d. Brouwer, Hämäläinen, Östergård and Sloane, in a 1998 paper, obtained upper bounds for $N(n_2, n_3, d)$ by studying a linear programming upper bound on the product of two assocation schemes. We study a semidefinite programming upper bound, sharpening the linear bound, that is based on triples of codewords. Representation theory of the isometry group is used to reduce the program in size. It yields 135 new upper bounds.

Semidefinite bounds for nonbinary codes based on quadruples

Sven Carel Polak
University of Amsterdam, Netherlands

Fix $n, q \in \mathbb{N}$. A *word* is an element $v \in [q]^n := \{1, 2, \ldots, q\}^n$. For two words $u, v \in [q]^n$, we define their *(Hamming) distance* $d_H(u, v)$ to be the number of i with $u_i \neq v_i$. A *code* is a subset of $[q]^n$. For any code $C \subseteq [q]^n$, the minimum distance $d_{\min}(C)$ of C is the minimum distance between any pair of distinct code words in C. Now we define, for a natural number d,

$$A_q(n, d) := \max\{|C| \mid C \subseteq [q]^n,\ d_{\min}(C) \geq d\}.$$

The parameter $A_q(n, d)$ is often hard to compute. It is the stable set number of the graph $G = (V, E)$ with $V := [q]^n$ and $E := \{\{u, v\} : 0 < d_H(u, v) < d\}$. A semidefinite program based on quadruples of codewords is given to find upper bounds on $A_q(n, d)$. By the symmetry of the problem, we can apply representation theory to reduce the problem to a semidefinite programming problem with order bounded by a polynomial in n. It yields the new upper bounds $A_4(6, 3) \leq 176$, $A_4(7, 3) \leq 596$, $A_4(7, 4) \leq 155$, $A_5(7, 4) \leq 489$ and $A_5(7, 5) \leq 87$.

This talk is based on joint work with Bart Litjens and Alexander Schrijver (University of Amsterdam).

Testing isomorphism of central Cayley graphs over an almost simple groups in polynomial time

Ilia Ponomarenko
St. Petersburg Department of V.A.Steklov Institute of Mathematics, Russia

It is proved that for any two central Cayley graph Γ and Γ' over an explicitly given almost simple group G of order n, the set $\mathrm{Iso}(\Gamma, \Gamma')$ can be found in time $\mathrm{Poly}(n)$.

Total graph coherent configurations: new graphs from Moore graphs

Leif K. Jørgensen
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For a graph Γ, the total graph $T(\Gamma)$ has vertex set $V(\Gamma) \cup E(\Gamma)$ and adjacency in $T(\Gamma)$ means adjacency/incidence in Γ. The automorphism group G of $T(\Gamma)$ is usually isomorphic to the automorphism group of Γ. The edge set of the complete graph with vertex set $V(T(\Gamma))$ is partitioned in orbits under the action of G. (Alternatively, we may consider a coarser, combinatorially defined partition, called the coherent configuration generated by $T(\Gamma)$.) Our goal is to construct a new graph with vertex set $V(T(\Gamma))$ and edge set a union of some of the orbits, and with automorphism group larger than G. A purely combinatorial alternative is to get a coherent configuration of small rank, generated in some sense by $T(\Gamma)$.

In particular we consider the case when Γ is the complement of a Moore graph. If Γ is the complement of the Petersen graph or the Hoffman-Singleton graph then we get graphs (in fact 4 class association schemes) of order 40 and 1100 with large automorphism groups. We will also discuss some properties for the case when Γ is the complement of a Moore graph of degree 57.

This is joint work with M. Klin and M. Ziv-Av, Ben-Gurion University of the Negev.

On non-commutative associations schemes of rank six

Mikhail Muzychuk
Netanya Academic College, Israel

In my talk I'll present the recent results about non-commutative association schemes of rank six.

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