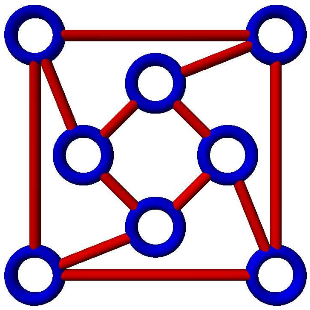

CSGT 2014
Abstracts

Edited by Petr Kovář

Organizing Committee:

Petr Kovář

Tereza Kovářová

Eva Schäfferová

Adam Silber

Michael Kubesa

Organizing Institutions:

Department of Applied Mathematics, VŠB–Technical University of Ostrava

Czech Mathematical Society of the Union of Czech Mathematicians and Physicists

The conference is partially supported the Faculty of Electrical Engineering and Computer Science, VŠB–Technical University of Ostrava.

CAYLEY GRAPHS OF DIAMETER TWO AND OF ORDER $\frac{d^2}{2}$

Marcel Abas

The number of vertices of a graph of diameter two and maximum degree d is at most d^2+1. This number is the Moore bound for diameter two. The order of largest Cayley graphs of diameter two and degree d is denoted by $C(d,2)$. The only known construction of Cayley graphs of diameter 2 valid for all degrees d gives $C(d,2) > \frac{1}{4}d^2+d$. However, there is a construction yielding Cayley graphs of diameter 2, degree d and order $d^2 - O(d^{\frac{3}{2}})$ for an infinite set of degrees d of a special type.In our talk we present a construction giving $C(d,2) \geq \frac{1}{2}d^2 - k$ for d even and of order $C(d,2)\frac{1}{2}(d^2+d) - k$ for d odd, $0 \leq k \leq 8$. In addition, we show that, in asymptotic sense, the most of record Cayley graphs of diameter two are obtained by our construction.

SHORT CYCLE COVERS OF CUBIC GRAPHS

Barbora Candráková*, Robert Lukoťka

A cycle cover of a graph G is a collection of cycles in G such that every edge from $E(G)$ is contained in at least one of the cycles. Long open conjecture by Alon and Tarsi states that every bridgeless graph on m edges has a cycle cover of length at most $1.4m$. The best known general result for bridgeless graphs is a cycle cover of total length at most $5m/3$ [Alon and Tarsi 1985; Bermond, Jackson, and Jaeger 1983]. The nowhere zero 5-flow conjecture implies existence of a cycle cover of length at most $1.6m$ [Jamshy, Raspaud, and Tarsi 1987]. The best result for bridgeless cubic graphs up to date is by Kaiser et al. (2010) giving a cycle cover of length at most $34m/21 \approx 1.619m$. We show that a bridgeless cubic graph G with m edges has a cycle cover of length at most $1.6m$. If G contains no circuits of length 5, then it has a cycle cover of length at most $14/9 \cdot m \approx 1.556m$.

DISTANCE MAGIC TYPES OF LABELINGS

Sylwia Cichacz

Let $G = (V, E)$ be a graph of order n. A *distance magic labeling* of G is a bijection $\ell\colon V \to \{1, 2, \ldots, n\}$ for which there exists a positive integer μ such that $\sum_{x \in N(v)} \ell(x) = \mu$ for all $v \in V$, where $N(v)$ is the open neighborhood of v. Moreover, we also consider a closed distance magic labeling as well as a Γ-distance magic labeling. Namely, in a *closed distance magic labeling* we take a sum of labels in closed neighborhood instead of open neighborhood of v. Whereas a Γ-*distance magic labeling* of a graph $G(V, E)$ with $|V| = n$ is an injection f from V to an Abelian group Γ of order n such that the weight $w(x) = \sum_{y \in N_G(x)} f(y)$ of every vertex $x \in V$ is equal to the same element $\mu \in \Gamma$. A graph G is called a *group distance magic* graph if there exists a Γ-distance magic labeling for every Abelian group Γ of order $|V(G)|$. The recent results in the topics will be presented in the talk.

FRACTIONAL CHROMATIC NUMBER

Zdeněk Dvořák

We give an overview of results on fractional chromatic number, with focus on sparse graphs (planar graphs, graphs on surfaces, bounded maximum degree, ...).

THE PACKING CHROMATIC NUMBER OF DISTANCE GRAPHS AND HANOI GRAPHS

Jan Ekstein*, Přemysl Holub, Olivier Togni

The packing chromatic number $\chi_\rho(G)$ of a graph G is the smallest integer p such that vertices of G can be partitioned into disjoint classes $X_1, ..., X_p$ where vertices in X_i have pairwise distance greater than i. First for $k < t$ we study the packing chromatic number of infinite distance graphs $D(k,t)$, i.e. graphs with the set $\mathbb{Z}$ of integers as vertex set and in which two distinct vertices $i, j \in \mathbb{Z}$ are adjacent if and only if $|i - j| \in \{k, t\}$. We also study the packing chromatic number of Hanoi graphs. The Hanoi graph H_n corresponding to the allowed moves in the tower of Hanoi problem can be constructed by taking the vertices to be the odd binomial coefficients of Pascal's triangle computed on the integers from 0 to $2^n - 1$ and drawing an edge whenever coefficients are adjacent diagonally or horizontally.

LINEAR-TIME ALGORITHMS FOR SCATTERING NUMBER AND HAMILTON-CONNECTIVITY OF INTERVAL GRAPHS

Hajo Broersma, Jiří Fiala*,
Petr A. Golovach, Tomáš Kaiser,
Daniël Paulusma, Andrzej Proskurowski

We prove that for all $k \leq -1$ an interval graph is $-(k+1)$-Hamilton-connected if and only if its scattering number is at most k. This complements a previously known fact that an interval graph has a nonnegative scattering number if and only if it contains a Hamilton cycle, as well as a characterization of interval graphs with positive scattering numbers in terms of the minimum size of a path cover. We also give an $O(n+m)$ time algorithm for computing the scattering number of an interval graph with n vertices and m edges, which improves the previously best-known $O(n^3)$ time bound for solving this problem. As a consequence of our two results, the maximum k for which an interval graph is k-Hamilton-connected can be computed in $O(n+m)$ time.

DENSITY CORRADI-HAJNAL THEOREM

Peter Allen, Julia Bottcher, Jan Hladky*, Diana Piguet

Mantel's Theorem — the simplest instance of Turán's Theorem — asserts than each n-vertex graph with more than $n^2/4$ edges contains a triangle. When the threshold $n^2/4$ is exceeded, one can then ask, how many triangles are. This "triangle density problem" was famously answered by Razborov in 2008. We find, for all sufficiently large n and each k, the maximum number of edges in an n-vertex graph which does not contain $k+1$ vertex-disjoint triangles. Our result can also be viewed as a density version of the Corrádi–Hajnal Theorem which considers minimum degree instead.

ON PATH-KIPAS RAMSEY NUMBERS

Binlong Li, Halina Bielak, Přemek Holub*

For two given graphs G_1 and G_2, the Ramsey number $R(G_1, G_2)$ is the least integer r such that for every graph G on r vertices, either G contains a G_1 or $\overline{G}$ contains a G_2. We use P_n to denote the path on n vertices, and $\widehat{K}_m$ the kipas on $m+1$ vertices, i.e., the graph obtained by joining K_1 with every vertex of P_m. In this talk, we determine the exact value of the path-kipas Ramsey numbers $R(P_n, \widehat{K}_m)$ for all n, m.

REGULAR MAPS AND TWISTED PROJECTIVE GROUPS

Katarína Hriňáková

Maps are cellular embeddings of graphs into closed compact surfaces. Regular maps are maps with the highest possible level of symmetry. A map is regular if its automorphism group acts regularly on the set of its flags (a flag is a mutually incident vertex-edge-face triple). We will focus on regular maps with automorphism group isomorphic to a twisted projective group and we will present classification of all regular maps on some small twisted projective groups.

GENERALIZED CAGES

Robert Jajcay

The notoriously hard Cage Problem - the problem of finding graphs of the smallest order for given degree and girth - has inspired a number of generalizations. After a (very) brief review of the status of the Cage Problem, we will present an overview of some of these generalizations, and will devote the second half of the talk to the case of biregular cages - cages in which we allow for two degrees instead of one. The construction techniques presented in the talk are mostly graph theoretical. One of the most interesting aspects of studying a closely related concept is the fundamental question of how much can one learn by this kind of loosening of the conditions with regard to the original problem.

SPLITTABILITY OF PERMUTATION CLASSES

Vít Jelínek*, Pavel Valtr

We say that a permutation p is 'merged' from permutations q and r, if we can color the elements of p red and blue so that the red elements are order-isomorphic to q and the blue ones to r. We say that a hereditary permutation class C is 'splittable', if it has two proper hereditary subclasses A and B such that any element of C can be obtained by merging an element of A with an element of B. In my talk, I will point out a connection between splittability of certain permutation classes and the notion of chi-boundedness of circle graphs. I will also explain how the notion of splittability helps in enumerating families of pattern-avoiding permutations, and how splittability relates to several other previously studied Ramsey-type properties.

HYPERGRAPHS OF d-INTERVALS

Tomáš Kaiser

Many combinatorial questions can be phrased in terms of a relation between the *matching number* $\nu(H)$ and the *transversal number* $\tau(H)$ of a hypergraph H from a certain class $\mathcal{H}$. While $\nu(H) \leq \tau(H)$ in general, $\tau(H)$ can be bounded by a function of $\nu(H)$ only in some of the classes $\mathcal{H}$. In this talk, we focus on the case where $\mathcal{H}$ is the class of *hypergraphs of d-intervals* — hypergraphs whose vertex set is the real line and whose hyperedges are unions of d closed intervals — and review known results and open problems related to the above parameters and their fractional relaxations. The talk is based on joint work with Ron Aharoni and Shira Zerbib.

WIENER INDEX OF ITERATED LINE GRAPHS OF TREES

Martin Knor*, Riste Škrekovski,
Primož Potočnik, Martin Mačaj

Let G be a graph. Its Wiener index, $W(G)$, is the sum of all distances in G. Iterated line graph $L^i(G))$ is defined recursively by $L^i(G) = L(L^{i-1}(G))$ for $i \geq 1$, while $L^0(G) = G$. Let T denote a tree. It is known that $W(L(T)) \neq W(T)$ if T is non-trivial, but $W(L^2(T)) = W(T)$ has infinitely many solutions. Dobrynin and Melnikov conjectured that in the class of trees $W(L^i(T)) = W(T)$ has no solution for $i \geq 3$. In a series of papers we disprove this conjecture and we completely characterize all the solutions. We also include some remarks about $W(L^2(T)) = W(T)$.

ON HANDICAP-TYPE LABELINGS

Petr Kovář*, Matěj Krbeček

We show how magic-type labeling can be used for scheduling sport tournaments. Especially we focus on so called handicap labelings that can be used to schedule incomplete tournaments in a more chalenging way for strong teams.

DESCRIBING 3-PATHS IN PLANE GRAPHS OF GIVEN GIRTH

Stanislav Jendroľ, Mária Kubíková*

The *girth* of a graph is the length of a shortest cycle in the graph. A path on three vertices u, v, and w is an (i, j, k)*-path* if $deg(u) \leq i, deg(v) \leq j$, and $deg(w) \leq k$.

The motivation for our research has come from the following results. Already in 1922 Franklin proved that every normal plane map G of minimum degree five contains a $(6, 5, 6)$-path. In 1993 Ando, Iwasaki and Kaneko showed that every 3-polytope contains a 3-path such that the sum of degrees of vertices of this path is at most 21. Jendroľ extended this result and described the types of 3-paths contained in each 3-polytope. In 2013 Borodin described the 3-paths in normal plane maps without two adjacent 3-vertices lying in two common 3-faces.

In this talk we consider simple plane graphs with minimum degree at least two and girth at least five. We describe the structure of the 3-paths in such graphs.

ON C-HEAVY SUBGRAPHS FOR HAMILTONICITY OF GRAPHS

BINLONG LI*, BO NING

Let G be a graph. A vertex is called to be heavy in G if it has degree at least $|V(G)|/2$ in G. Let G' be an induced subgraph of G. If for every maximal clique T of G', each nontrivial component of $G'-T$ contains a heavy vertex of G, then we say G' is c-heavy in G. For a given graph H, we say that G is H-c-heavy if every induced subgraph of G is isomorphic H is c-heavy. We characterize all the pairs of connected graphs $\{R, S\}$ such that for any 2-connected graph G, G being R, S-c-heavy implies G is hamiltonian. Our results extend the the results of forbidden subgraph conditions for hamiltonicity by Bedrossian, Faudree and Gould.

AVOIDING SHORT CIRCUITS IN 2-FACTORS OF CUBIC GRAPHS

BARBORA CANDRÁKOVÁ, ROBERT LUKOŤKA*

Each bridgeless cubic graph has a perfect matching and thus it has a complementary 2-factor. We develop techniques to construct 2-factors with bounded number of circuits of prescribed length(s) (for lengths 2 to 7) with focus on circuits of length 5. We show that a bridgeless cubic graph G of order n other than Petersen graph has a 2-factor with at most $(n-2)/7.5$ circuits of length 5. If G is 3-edge-connected, the bound improves to $n/9$. Both bounds are attained for infinite family of graphs. If G is cyclically 4-edge-connected, the bound improves to $n/10$. We sketch application of our results to short cycle covers and travelling salesman problem on cubic graphs.

CHARACTERISTIC FLOWS ON SIGNED GRAPHS AND SHORT CIRCUIT COVERS

EDITA MÁČAJOVÁ*, MARTIN ŠKOVIERA

We generalise to signed graphs a classical result of Tutte [Canad. J. Math. 8 (1956), 13–28] stating that every integer flow can be expressed as a sum of characteristic flows of circuits. In our generalisation the rôle of circuits is taken over by signed circuits of a signed graph which occur in two types – either balanced circuits or pairs of disjoint unbalanced circuits connected with a path intersecting them only at its ends. As an application of this result we show that a signed graph G admitting a nowhere-zero k-flow has a covering with signed circuits of total length at most $2(k-1)|E(G)|$.

GENERALIZED THUE SEQUENCES

MARTINA MOCKOVČIAKOVÁ

A sequence is *Thue* or *nonrepetitive* if it does not contain a repetition of any length. In this talk we introduce a generalization of this notion. A k-subsequence of a sequence S is a subsequence containing every k-th term of S. A *k-Thue sequence* is a sequence in which every ℓ-subsequence, for $1 \leq \ell \leq k$, is also Thue.

We show that four symbols are enough to build a 2-Thue sequence of any length. Moreover, we prove that four symbols suffice also for circular 2-Thue sequences, with three exceptions. As a corollary, the tight bounds for total Thue coloring of paths and cycles are obtained.

COLORING FRACTIONAL POWERS OF GRAPHS

Stephen G. Hartke, Hong Liu,
Šárka Petříčková*

For $m, n \in \mathbb{N}$, the fractional power $G^{\frac{m}{n}}$ of a graph G is the mth power of the n-subdivision of G, where the n-subdivision is obtained by replacing each edge in G with a path of length n. It was conjectured by Iradmusa that if G is a connected graph with $\Delta(G) \geq 3$ and $1\omega(H^{\frac{3}{5}})$. However, we prove that the conjecture is true if m is even. We also study the case when m is odd, obtaining a general upper bound $\chi(G^{\frac{m}{n}}) \leq \omega(G^{\frac{m}{n}}) + 2$ for graphs with $\Delta(G) \geq 4$.

THE LOEBL-KOMLOS-SOS CONJECTURE

Diana Piguet

Extremal graph theory investigates which general properties of a graph force the appearance of a given substructure. For illustration, I mention Mantel's theorem, which states that any n-vertex graph with more than $\lceil \frac{n}{2} \rceil \cdot \lfloor \frac{n}{2} \rfloor$ edges contains a triangle. In this talk, I will the following setting. Given a family of trees, what general properties of a graph ensure the presence of the copy of every member of this family? If we consider the family of all trees of order k, a minimum degree of $k-1$ is sufficient, as a simple greedy algorithm finds the desired copy. There are two ways to relax the condition of the minimum degree. If we consider the average degree instead, this leads to the famous Erdős–Sós Conjecture, which asserts that any graph with average degree strictly larger than $k-2$ contains a copy of any tree of order k. On the other hand, one can consider the median degree instead. A graph G has *median degree* d, if half of its vertices have degree at least d and the other half have degree at most d.

Conjecture 1 (Loebl-Komlós–Sós) *Every graph with median degree at least $k-1$ contains a copy of any tree of order k.*

I shall present the solution of the Loebl–Komlós–Sós Conjecture for dense graphs (i.e., for graphs with $\Theta(n^2)$ edges) and the approximate solution of the conjecture for sparse graphs (i.e., for graphs with $o(n^2)$ edges). The tools used in the dense setting is a combination of Szemerédi's Regularity Lemma and the stability method. In the setting of sparse graphs, one cannot use directly Szemerédi's Regularity Lemma, as its assertion is void for such graphs. There exists a regularity lemma for sparse graphs, but its statement is not sufficiently general to approach this conjecture. To prove the approximate version of the Loebl–Komlós–Sós Conjecture, we used a novel graph decomposition technique that generalises Szemerédi's Regularity Lemma and is applicable to any graph with average degree at least c for some large constant $c \in \mathbb{N}$. This is joint work with Jan Hladký, János Komlós, Miklós Simonovits, Maya Stein, and Endre Szemerédi.

WHAT IS THE MAXIMUM ORDER OF A PLANAR SIGNED CLIQUE?

Reza Naserasr, Edita Rollová*, Éric Sopena

A homomorphism of G to H is a mapping from $V(G)$ to $V(H)$ such that an edge of G is mapped to an edge of H. Homomorphisms are related to (proper) vertex colourings since a vertex v of G can be "coloured" by the vertex of H that is a homomorphic image of v. In this way the chromatic number of G is simply the smallest order of a homomomorphic image of G. We define a clique to be a graph on n vertices that has chromatic number n. In this talk we will focus on signed graphs, graphs where each edge is either positive or negative. We will define vertex colouring of signed graphs using signed graph homomorphisms and answer the question of the title in general. For all-positive signed graphs, which correspond to graphs, the answer is given by the Four-Colour-Theorem and by the existence of a planar clique on four vertices, and therefore is 4.

GENERALIZED FRACTIONAL AND CIRCULAR COLORINGS

Roman Soták

An additive hereditary property of graphs is a class of simple graphs which is closed under unions, subgraphs and isomorphism. Let $\mathcal{P}$ and $\mathcal{Q}$ be additive hereditary properties of graphs. For positive integers r, s a *(weak)* $(\mathcal{P}, \mathcal{Q})$*-total fractional/circular* (r, s)*-coloring* of a simple graph G is a coloring of the vertices $V(G)$ and edges $E(G)$ of G by arbitrary/consecutive s-element subsets of $\mathbf{Z}_r$ such that for each color i the vertices colored by sets containing i induce a subgraph of property $\mathcal{P}$, the edges colored by sets containing i induce a subgraph of property $\mathcal{Q}$ and incident vertices and edges obtain disjoint sets. We present general basic results on $(\mathcal{P}, \mathcal{Q})$-total fractional/circular (r, s)-colorings. For specific properties we determine the $(\mathcal{P}, \mathcal{Q})$-total fractional and circular chromatic numbers of complete graphs.

AN FPT ALGORITHM FOR TREE DELETION SET

Venkatesh Raman, Saket Saurabh,
Ondřej Suchý*

We give a $5^k n^{O(1)}$ time fixed-parameter algorithm for determining whether a given undirected graph on n vertices has a subset of at most k vertices whose deletion results in a tree. Such a subset is a restricted form of a feedback vertex set. While parameterized complexity of feedback vertex set problem and several of its variations have been well studied, to the best of our knowledge, this is the first fixed-parameter algorithm for this version of feedback vertex set.

FORBIDDEN SUBGRAPHS AND RAINBOW CONNECTION IN GRAPHS WITH MINIMUM DEGREE 2

Petr Vrána*, Přemysl Holub,
Zdeněk Ryjáček, Ingo Schiermeyer

A connected edge-colored graph G is rainbow-connected if any two distinct vertices of G are connected by a path whose edges have pairwise distinct colors; the rainbow connection number $\mathrm{rc}(G)$ of G is the minimum number of colors such that G is rainbow-connected.

We consider families $\mathcal{F}$ of connected graphs for which there is a constant $k_{\mathcal{F}}$ such that, for every connected $\mathcal{F}$-free graph G with minimum degree 2, $\mathrm{rc}(G) \leq \mathrm{diam}(G) + k_{\mathcal{F}}$, where $\mathrm{diam}(G)$ is the diameter of G . We show that condition holds for the families $\mathcal{F}_1 = \{Z_3, S_{3,3,3}\}$,$\mathcal{F}_2 = \{S_{2,2,2}, N_{2,2,2}\}$.

UNIQUE-MAXIMUM EDGE-COLOURING OF PLANE PSEUDOGRAPHS

Igor Fabrici, Stanislav Jendroľ,
Michaela Vrbjarová*

A unique-maximum k-edge-colouring with respect to faces of a 2-edge-connected plane pseudograph G is an edge-colouring with colours from the set $\{1, 2 \ldots, k\}$ such that for each face f of G the maximum colour occurs exactly once on the edges of f. We will prove that any 2-edge-connected plane pseudograph has such a colouring with 3 colours in general and if we require the colouring to be facially-proper, then 6 colours are enough to colour every 2-edge-connected plane pseudograph.

LIST OF PARTICIPANTS CSGT 2014

June 9–13, 2014, Teplice nad Bečvou, Czech Republic

Marcel Abas

Slovak University of Technology
`e-mail: abas@stuba.sk`

Jan Brousek

University of West Bohemia
`e-mail: brousek@kma.zcu.cz`

Barbora Candráková

Comenius University
`e-mail: candrakova@dcs.fmph.uniba.sk`

Sylwia Cichacz-Przenioslo

AGH University of Science and Technology
`e-mail: cichacz@agh.edu.pl`

Zdeněk Dvořák

Charles University
`e-mail: rakdver@iuuk.mff.cuni.cz`

Jan Ekstein

University of West Bohemia
`e-mail: ekstein@kma.zcu.cz`

Jiří Fiala

Charles University
`e-mail: fiala@kam.mff.cuni.cz`

Jan Hladký

University of Warwick
`e-mail: honzahladky@gmail.com`

Přemysl Holub

University of West Bohemia
`e-mail: holubpre@kma.zcu.cz`

Katarína Hriňáková

Slovak University of Technology in Bratislava
e-mail: hrinakova@math.sk

Róbert Jajcay

Comenius University
e-mail: robert.jajcay@fmph.uniba.sk

Vít Jelínek

Charles University
e-mail: jelinek@iuuk.mff.cuni.cz

Eva Jelínková

Charles University
e-mail: eva@kam.mff.cuni.cz

Tomáš Kaiser

University of West Bohemia
e-mail: kaisert@kma.zcu.cz

Martin Knor

Slovak University of Technology in Bratislava
e-mail: knor@math.sk

Petr Kovář

VŠB – Technical University of Ostrava
e-mail: petr.kovar@vsb.cz

Tereza Kovářová

VŠB – Technical University of Ostrava
e-mail: tereza.kovarova@vsb.cz

Mária Kubíková

P. J. Šafárik University in Košice
e-mail: maja.kubikova@gmail.com

Binlong Li

University of West Bohemia
e-mail: binlong@ntis.zcu.cz

Robert Lukoťka

Trnava University
e-mail: robert.lukotka@truni.sk

Edita Máčajová

Comenius University
e-mail: macajova@dcs.fmph.uniba.sk

Martina Mockovčiaková

University of West Bohemia
e-mail: mmockov@ntis.zcu.cz

Šárka Petříčková

University of West Bohemia
e-mail: sarpetka@gmail.com

Diana Piguet

University of West Bohemia
e-mail: diana.piguet@gmail.com

Edita Rollová

University of West Bohemia
e-mail: rollova@ntis.zcu.cz

Adam Silber

VŠB – Technical University of Ostrava
e-mail: adam.silber@vsb.cz

Roman Soták

P. J. Šafárik University in Košice
e-mail: roman.sotak@upjs.sk

Ondřej Suchý

Czech Technical University in Prague
e-mail: ondrej.suchy@fit.cvut.cz

Petr Vrána

University of West Bohemia
e-mail: vranap@kma.zcu.cz

Michaela Vrbjarová

P. J. Šafárik University in Košice

e-mail: michaela.vrbjarova@gmail.com

Zatím je ve sborníku 26 abstraktů. Přihlášeno je 30 účastníků.