**2021 Coast Combinatorics Conference**, 6 March 2021
on **Zoom**, hosted by the University of Victoria
email gmacgill@uvic.ca if the link is needed

# Schedule

9:45 **Zoom meeting starts**. Bring coffee.

10:00-10:30 *Parity Theorems about Paths, Cycles and Trees in Graphs*
**Kathie Cameron**, Wilfred Laurier University

10:40-11:10 *Invariant Galton-Watson trees*
**Yevgeniy Kovchegov**, Oregon State University

11:20-noon *Acyclic graphs with at least* $2\ell + 1$ *vertices are* $\ell$*-recognizable*
**Douglas B. West**, Zhejiang Normal University and University of Illinois

12:00-1:00 **Lunch break**: is the kitchen nearby?

1:00-1:30 *Using Permutation Rational Functions for Permutation Arrays with Large Hamming Distance*
**I. Hal Sudborough**, University of Texas at Dallas

1:40-2:10 *Exact formulas for the number of binary trees with given Horton and Tokunaga numbers*
**Evgenia Chunikhina**, Pacific University

2:20-2:50 2*-Limited Broadcast Domination in Cylindrical Grid Graphs*
**Aaron Slobodin**, University of Victoria

3:00 **End** of scheduled talks, start of Happy Hour

# **Abstracts** in speaker order

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**Kathie Cameron**, Wilfrid Laurier University
*Parity Theorems about Paths, Cycles and Trees in Graphs*

Carsten Thomassen and I proved that in any graph $G$, the number of cycles containing a specified edge as well as all the odd-degree vertices is odd if and only if $G$ is eulerian. Where all vertices have even degree this is a theorem of Shunichi Toida and where all vertices have odd degree it is Andrew Thomason's extension of Smith's Theorem. Andrew Thomason proved his theorem by constructing a graph $X(G)$ in which the odd-degree vertices correspond precisely to the things he wants to show there are an even number of, namely the hamiltonian cycles containing the specified edge. This provides an algorithm for given one of the objects, finding another. I have extended Thomason's algorithm to one which, in a non-eulerian graph, finds a second cycle containing a specified edge and all the odd-degree vertices. I will discuss some other parity theorems about paths, cycles, and trees in graphs; in particular, attempts to find proofs of them by showing that the objects of interest are the odd-degree vertices of an associated (generally large) graph.

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**Yevgeniy Kovchegov**, Oregon State University
*Invariant Galton-Watson trees*

We introduce a one-parameter family of critical Galton-Watson tree measures invariant under the operation of Horton pruning (cutting tree leaves with subsequent series reduction). Assuming a type of regularity, this family of measures are the attractors of critical Galton-Watson trees under Horton pruning. These invariant measures follow Horton law. Their Tokunaga coefficients satisfy Toeplitz property.

This is a joint work with Ilya Zaliapin (University of Nevada Reno).

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**Douglas B. West**, Zhejiang Normal University and University of Illinois
*Acyclic graphs with at least $2\ell+1$ vertices are $\ell$-recognizable*

The $(n-\ell)$-*deck* of an $n$-vertex graph is the multiset of subgraphs obtained from it by deleting $\ell$ vertices. An $n$-vertex graph is $\ell$-reconstructible if no graph nonisomorphic to it has the same $(n-\ell)$-deck. A family of $n$-vertex graphs is $\ell$-*recognizable* if every graph having the same $(n-\ell)$-deck as a graph in the family is also in the family.

In this talk, we review recent progress on $\ell$-reconstruction and focus on the new result that the family of $n$-vertex graphs having no cycles is $\ell$-recognizable when $n \geq 2\ell+1$ (except for $(n,\ell)=(5,2)$). The result is sharp; the conclusion fails when $n=2\ell$.

This work is joint with Alexandr V. Kostochka, Mina Nahvi, and Dara Zirlin.

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**I. Hal Sudborough**, University of Texas at Dallas
*Using Permutation Rational Functions for Permutation Arrays with Large Hamming Distance*

We consider permutation rational functions (PRFs), $V(x)/U(x)$, where both $V(x)$ and $U(x)$ are polynomials over a finite field $\mathbb{F}(q)$. PRFs have been the subject of several recent papers. Let $M(n, D)$ denote the maximum number of permutations on n symbols with pairwise Hamming distance $D$. Computing lower bounds for $M(n, D)$ is the subject of current research with applications in error correcting codes. Using of specified degrees we obtain improved lower bounds for $M(q, q-d)$ and $M(q+1, q-d)$, for $d$ in $\{4, 5, 6, 7, 8, 9\}$.

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**Evgenia Chunikhina**, Pacific University
*Exact formulas for the number of binary trees with given Horton and Tokunaga numbers*

Tree-like patterns are ubiquitous in nature. Botanical trees, river networks, and blood systems are the most well-known examples of complex hierarchical systems met in observations. Interestingly, many of such systems exhibit one of the two types of self-similarity: Horton self-similarity and Tokunaga self-similarity. In this talk I will present a novel formula that calculates the number of binary trees with given Tokunaga numbers. An application of these results in information theory will be discussed briefly.

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**Aaron Slobodin**, University of Victoria
2-*Limited Broadcast Domination in Cylindrical Grid Graphs*

Suppose there is a transmitter located at each vertex of a graph $G$. A $k$-limited broadcast on $G$ is an assignment of the integers $0, 1, \ldots, k$ to the vertices of $G$. The integer assigned to the vertex $x$ represents the strength of the broadcast from $x$, where strength 0 means the transmitter at $x$ is not broadcasting. A broadcast of positive strength $s$ from $x$ is heard by all vertices at distance at most $s$ from $x$. A $k$-limited broadcast is called dominating if every vertex assigned 0 is within distance $d$ of a vertex whose transmitter is broadcasting with strength at least $d$. The $k$-limited broadcast domination number of $G$ is the minimum possible value of the sum of the strengths of the broadcasts in a $k$-limited dominating broadcast of $G$. Observe that the 1-limited broadcast domination number of $G$ equals the domination number of $G$.

We give tight upper and lower bounds for the 2-limited broadcast domination number of the Cartesian products of a path and a cycle. We present computational method which we use to improve our lower bounds to determine periodically optimal solutions.

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**END**