Finite Fields in Combinatorics I

(Org: **Daniel Panario** (Carleton University))

TIM ALDERSON, UNB Saint John

Constructions of multiple wavelength codes ideal auto-correlation

Several new families of multiple wavelength (2-dimensional) optical orthogonal codes (2D-OOCs) with ideal auto-correlation $\lambda_a = 0$ are presented. Such codes have at most one pulse per wavelength. Our constructions produce codes that are either optimal with respect to the Johnson bound (J-optimal), or are asymptotically optimal and maximal. The constructions are based on certain point-sets in projective or affine spaces over finite fields. The techniques may also be used to produce multiple weight codes.

SHONDA GOSSELIN, University of Winnipeg

Paley uniform hypergraphs

The well known Paley graphs are constructed on finite fields. These graphs are vertex-transitive, self-complementary, and have many other interesting properties. We introduce the Paley graph construction and look at some examples, and then use Paley's algebraic technique to construct some k-uniform hypergraphs with properties analogous to those of the Paley graphs, such as vertex-transitivity, self-complementarity, and more generally, q-complementarity.

PETR LISONEK, Simon Fraser University

On the equivalence of quantum codes

Quantum codes detect and correct errors in quantum information. Some families of quantum codes are additive (or linear) codes over the field $\mathrm{GF}(4)$. Monomial equivalence of classical codes does not quite match the notion of equivalence among quantum codes. Combinatorially this is demonstrated by constructing graph states that are not equivalent under the vertex neighbourhood complementation procedure. Only a few ad-hoc counterexamples are known so far; we aim at understanding them and extending them.

DANIEL PANARIO, Carleton University

Combinatorial Applications of Finite Fields

Finite fields are applied in many areas of pure and applied mathematics. In this talk we survey several areas of combinatorics where finite fields are frequently used. We illustrate this usage with some examples. This talk serves as an introduction for the other talks in this minisymposium.

DAVID THOMSON, Carleton University

Sets of mutually orthogonal Latin hypercubes

A (d, n, r, t)-hypercube of dimension d, order n, class r and type t is an $n \times n \times \cdots \times n$ (d times) array on n^r symbols such that, in every rt-codimension-subarray, each of the n^r symbols appears exactly $n^{d-r(t+1)}$ times. We introduce bounds on the number of mutually orthogonal *Latin* ($t = 1$) hypercubes (MOLHs). When n is a prime power, we use permutation polynomials over finite fields to construct sets of MOLHs approaching these bounds.