Finite Geometry
Géométrie finie
(Org: **Tim Alderson** (UNB) and/et **Brett Stevens** (Carleton))

TIM ALDERSON, University of New Brunswick Saint John
t-Extensions of Linear Codes

For $n \geq k$, an $(n, k, d)_q$*-code* C is a collection of q^k n-tuples (or *codewords*) over an alphabet $\mathcal{A}$ of size q such that the minimum (Hamming) distance between any two codewords of C is d. For such a code, the Singleton bound $\left(|C| \leq |\mathcal{A}|^{n-d+1}\right)$ gives $d \leq n-k+1$. The *Singleton defect of* C, $S(C)$, is defined by $S(C) = n-k+1-d$. A code C' obtained by deleting some fixed t coordinates from each codeword of C is called a t-punctured code of C. In the case that $S(C') = S(C)$, C is said to be a t-extension of C', equivalently, C' is said to be *extendable* to the code C. A code is *maximal* if it admits no extensions.

In this talk I shall discuss the question of non-linear t-extendability of linear codes, and describe some recent progress obtained by utilizing the Alderson-Bruen-Silverman (ABS) model of linear codes. Some open problems will also be presented.

AIDEN BRUEN, Carleton University
An extension of Desargues Theorem

The celebrated theorem of Desargues asserts that if two triangles are in perspective the intersections of corresponding sides are collinear. Here we outline a new result on the intersections of the non-corresponding sides.

Time permitting a connection between Desargues and graph theory is described [joint work with Dr. Trevor Bruen and Professor McQuillan].

JAMES MCQUILLAN, Western Illinois University
Desargues configurations with self-conjugate points

Desargues theorem states that, if two triangles are in perspective from a point, then the intersections of the corresponding sides are collinear. The associated 10 points and 10 lines form a Desargues configuration. We consider Desargues configurations in a projective plane over a field, and the unique polarity associated with a Desargues configuration. We focus on self-conjugate points in a Desargues configuration. Interestingly, fields of characteristic 2 and 3 both play special roles. This is joint work with Professor Aiden Bruen, Carleton University.

JOHN SHEEKEY, University College Dublin
Finite Geometry and Rank-Metric Codes

It is well known that there is a correspondence between codes in the hamming metric and sets of points in a projective space, where weights of codewords correspond to intersection properties of this set with hyperplanes. In the extremal case, we have the classical correspondence between MDS codes and arcs.

Codes in the rank-metric have been studied since Delsarte (1978) and Gabidulin (1985), but have had increased attention in recent years due to potential applications in Network Coding and Code-based Cryptography.

In this talk we outline a natural correspondence between codes in the rank-metric and linear sets in a projective space. Linear sets have been studied in finite geometry for the past 20 years. These two topics have developed independently until recently, so there are various results and techniques in each which translate to interesting and non-trivial results in the other. We will present recent results and open problems arising from this new correspondence.

BRETT STEVENS, Carleton University

Affine planes with ovals for blocks

A beautiful theorem states that the reverse of a line in the Singer Cycle presentation of a projective plane is an oval. This implies that for every Desarguesian projective plane there is a companion plane all of whose blocks are ovals in the first. This fact has been exploited to construct a family of very efficient strength 3 covering arrays. We show that there exist pairs of Desarguesian affine planes whose blocks are ovals in the other plane for any order a power of 2. These can also be used to construct efficient covering arrays.

DAVID WEHLAU, Royal Military College

Planes, Division Sequences and ZZ-topes

We consider the algebraic closure F of the field of order p as an infinite dimensional vector space over the prime field. A natural problem in representation theory leads to the question of describing the two dimensional subspaces of F. In particular, we wish to describe the orbits of these planes under the natural action of the non-zero scalars F^*. The solution to this problem leads to an infinite sequence of polynomials for each prime p. These polynomials have a number of remarkable properties. Studying these polynomials reveals deep connections with number theory and combinatorics.

Joint work with H.E.A. Campbell, University of New Brunswick