Links Between Plateaued Functions and Partial Geometric Difference Sets

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Combinatorial designs have fruitful links to graph theory, coding theory and study of Boolean functions. It's deep connections to other fields attracted many researchers from different fields of application problems. Difference set methods provide a powerful tool to construct designs and other combinatorial objects with large automorphism groups. For example, symmetric difference sets can be used to construct symmetric designs; relative difference sets can be used to construct divisible designs; partial difference sets can be used to construct strongly regular graphs; Hadamard difference sets can be used to construct bent functions.

In this talk we will focus on partial geometric difference sets (PGDS) and their connections to graphs and plateaued functions.

Well-known examples of partial geometric designs include 2-designs, partial geometries and transversal designs. The existence of a PGDS implies the existence of a symmetric partial geometric design (sometimes called a $1\frac{1}{2}$ *design* [1]). Also the existence of a Boolean plateaued function f with Fourier spectrum $\{0, \pm 2^t\}$ is equivalent to existence of a partial geometric difference set with parameters $(v = 2^{s+1}, k; \alpha, \beta)$ satisfying $\beta - \alpha = 2^{2t-2}$ and $k \in \{2^s, 2^s \pm 2^{t-1}\}$ [2].

We will provide some properties of graphs obtained from PGDS and investigate connections between Boolean functions and these graphs. Also we will investigate the links between image sets of plateaued functions and partial geometric difference set.

References

[1] A. Neumaier, $t\frac{1}{2}$-*designs*. J. Comb. Th. (Ser. A), vol. 28, No. 3, pages 226-248, 1980.

[2] O Olmez, *Plateaued functions and one-and-half difference sets*. Designs, Codes and Cryptography, Sep 1 vol. 76, No. 3, pages 537-49, 2015.