Abstract

Intersection Distribution and Its Application

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Given a polynomial f over finite field $\mathbb{F}_q$, its intersection distribution concerns the collective behaviour of a series of polynomials $\{f(x)+cx|c \in \mathbb{F}_q\}$. Each polynomial f canonically induces a $(q+1)$-set S_f in the classical projective plane $PG(2,q)$ and the intersection distribution of f reflects how the point set S_f interacts with the lines in $PG(2,q)$.

Motivated by the long-standing open problem of classifying oval monomials, which are monomials over $\mathbb{F}_{2^m}$ having the same intersection distribution as x^2, we consider the next simplest case: classifying monomials over $\mathbb{F}_q$ having the same intersection distribution as x^3. Some characterizations of such monomials are derived and consequently a conjectured complete list is proposed.

Among the conjectured list, we identify two exceptional families of monomials over $\mathbb{F}_{3^m}$. Interestingly, new examples of Steiner triple systems follow from them, which are nonisomorphic to the classical ones.

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