SEMINARIO

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Weierstrass semigroup at m+1 rational points in maximal curves which cannot be covered by the Hermitian curve

Abstract:

Let $\mathcal{X}$ be a non-singular, projective, irreducible, algebraic curve of genus $g \geq 1$ over a finite field $\mathbb{F}_q$. Fix m distinct rational points $P_1, \ldots, P_m$ on $\mathcal{X}$. The set $H(P_1, \ldots, P_m) = \{(a_1, \ldots, a_m) \in \mathbb{N}_0^m \,;\, \exists f \in \mathbb{F}_q(\mathcal{X}) \text{ with } (f)_\infty = \sum_{i=1}^m a_i P_i\}$ is called the Weierstrass Semigroup in the points $P_1, \ldots, P_m$. This semigroup is very important to calculate the parameters of algebraic geometry codes (AG codes) over $\mathcal{X}$. In general, is very complicate determinate this semigroup and various efforts have been possible for certain types of curves. In 2018, joint with G. Tizziotti, we determinate the generator set $\Gamma(P_1, \ldots, P_m)$ of $H(P_1, \ldots, P_m)$ for curves $\mathcal{X}$ with affine plane model $f(y) = g(x)$, using the concept of discrepancy on two rational points P, Q over $\mathcal{X}$, introduced by Duursma and Park. With certain conditions, we will show how we can calculate the set $\Gamma(P_1, \ldots, P_m)$ for two types of maximal curves which cannot covered by the Hermitian curve. The first family the curves that we present is the example given by Giulietti and Korchmáros: For $q = n^3$, with $n \geq 2$ a prime power, the GK curve over $\mathbb{F}_{q^2}$ is the curve in $\mathbb{P}^3(\overline{\mathbb{F}}_{q^2})$ with equations $Z^{n^2-n+1} = Y \sum_{i=0}^n (-1)^{i+1} X^{i(n-1)}$, $X^n + X = Y^{n+1}$. The second family was introduced in 2016, by Tafazolian, Teherán and Torres: For $a, b, s \geq 1, n \geq 3$ integers such that n is odd. Let $q = p^a$ a power of a prime, b is a divisor of a, s is a divisor of $(q^n + 1)/(q + 1)$ and $c \in \mathbb{F}_{q^2}$ with $c^{q-1} = -1$. We define the curve $\mathcal{X}_{a,b,n,s}$ over $\mathbb{F}_{q^{2n}}$ with equations $cy^{q+1} = t(x) := \sum_{i=0}^{a/b-1} x^{p^{jb}}$ and $z^M = y^{q^2} - y$ where $M = (q^n + 1)/(s(q + 1))$.

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