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Reversed Dickson polynomials of the (k+1)-th kind over finite fields

Let p be a prime and q a power of p. Let $\mathbb{F}_q$ be the finite field with q elements. The concept of the reversed Dickson polynomial $D_n(a,x)$ was first introduced by Xiang-dong Hou, Gary Mullen, James Sellers and Joseph Yucas in 2009 by reversing the roles of the variable and the parameter in the Dickson polynomial $D_n(x,a)$. In 2012, Steven Wang and Joseph Yucas introduced the reversed Dickson polynomials of the $(k+1)$-th kind $D_{n,k}(a,x)$. For $a \in \mathbb{F}_q$, the n-th reversed Dickson polynomial of the $(k+1)$-th kind $D_{n,k}(a,x)$ is defined by

$$D_{n,k}(a,x) = \sum_{i=0}^{\lfloor \frac{n}{2} \rfloor} \frac{n-ki}{n-i} \binom{n-i}{i} (-x)^i a^{n-2i},$$

and $D_{0,k}(a,x) = 2-k$.

I am primarily interested in the question: When is $D_{n,k}(a,x)$ a permutation polynomial of $\mathbb{F}_q$? In this talk, I will explain my recent results on the permutation behavior of reversed Dickson polynomials over finite fields. I will also talk about some general properties of the reversed Dickson polynomials of the $(k+1)$-th kind. These results unify and generalize many previously discovered results on reversed Dickson polynomials over finite fields. Moreover, I will talk about my current research on reversed Dickson polynomials.