An Explicit Construction of Universally Decodable Matrices.

Universally decodable matrices (UDMs) can be used for coding purposes when transmitting over slow fading channels. These matrices are parameterized by positive integers $L$ and $n$ and a prime power $q$: $L$ matrices $A_0, \ldots, A_{L-1}$ over $\mathbb{F}_q$ and size $n \times n$ are $(L, n, q)$-UDMs if for every non-negative integers $k_0, \ldots, k_{L-1}$ with $k_0 + \cdots + k_{L-1} \geq n$ they fulfill the UDMs condition which says that the $(\sum_{\ell=0}^{L-1} k_{\ell}) \times n$ matrix composed of the first $k_0$ rows of $A_0$, the first $k_1$ rows of $A_1$, $\ldots$, the first $k_{L-1}$ rows of $A_{L-1}$ has full rank. Based on Pascal’s triangle we give an explicit construction of universally decodable matrices for any non-zero integers $L$ and $n$ and any prime power $q$ where $L \leq q + 1$. This is the largest set of possible parameter values since for any list of universally decodable matrices the value $L$ is upper bounded by $q + 1$, except for the trivial case $n = 1$. For the proof of our construction we use properties of Hasse derivatives, and it turns out that our construction has connections to Reed-Solomon codes, algebraic-geometry codes, and so-called repeated-root cyclic codes. (Received August 22, 2005)