Application of our GO-UP Construction to Goppa Codes to Construct Quantum Error-Correcting Codes

Eddie Arrieta*, Dr. Heeralal Janwa, University of Puerto Rico, Río Piedras Campus.

Given a code $C$ over the finite field $\mathbb{F}_q$, where $q$ is a power of a prime number, some constructions exist that permit us to obtain a new code from $C$ over $\mathbb{F}_q$ or over a subfield of $\mathbb{F}_q$, for example as subfield subcodes. However in some important applications one needs codes over an extension field, for example in quantum error-correcting codes. We have proposed a novel technique that we call Go-Up construction, which allows us to obtain an additive or a linear code over $\mathbb{F}_{q^m}$ from $C$. In general, given two linear codes $C_0$ and $C_1$ in $\mathbb{F}_q^n$, and using a polynomial or normal basis of $\mathbb{F}_{q^m}$ over $\mathbb{F}_q$, we obtain a code $\text{GU}(C_0, C_1)$ over $\mathbb{F}_{q^m}$ that is always additive and, under certain condition, it is $\mathbb{F}_{q^m}$ linear. We have shown under what condition is this code a self-orthogonal or self-dual code. In this talk we will show that when $C_i = \Gamma(g_i(x), L_i)$ are $q$-ary Goppa codes, we can use these codes to construct quantum error-correcting codes and determine their parameters.

Under certain conditions, we show that the GU of two Goppa codes is a Goppa code. We explore when we might be able to use Patterson’s $O(n, \log n)$ algorithm to apply to correct quantum errors.

Keywords: Go-Up construction, Goppa code, polynomial basis, quantum errors.