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

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Given a code C over the finite field $\mathbb{F}_q$, where q is a power of a prime number, some constructions exists 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 $\mathbf{GU}(C_0, C_1)$ 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.