Non-separable constructions, quantum codes

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A unitary matrix is a matrix U satisfying $UU^* = 1$.

A one-dimensional (1D) *paraunitary matrix* is a polynomial matrix $U(z)$ in the variable z such that $U(z)U^*(z^{-1}) = 1$. A k-dimensional (kD) paraunitary matrix is a polynomial matrix $U(\mathbf{z})$ in the (commuting) variables $\mathbf{z} = (z_1, z_2, \ldots, z_k)$ such that $U(\mathbf{z})U^*(\mathbf{z}^{-1}) = 1$ where $\mathbf{z}^{-1} = (z_1^{-1}, z_2^{-1}, \ldots, z_k^{-1})$.

What are the building blocks for paraunitary matrices? The answer is known for the 1D case.

How does one build multidimensional paraunitary matrices? What are required are *non-separable* such multidimensional matrices. Non-separable essentially means it cannot be broken down as a (non-trivial) product of paraunitary matrices nor as a tensor product of such. (Sounds familiar from quantum?)

I will discuss the construction of non-separable multidimensional paraunitary matrices using orthogonal systems of idempotents together with a related matrix 'tangle' product.

If time allows I will discuss relationships with the construction of some quantum codes.

Paraunitary matrices are important in signal processing; more specifically: '..in the research area of multirate filterbanks, wavelets and multiwavelets, the concept of a paraunitary matrix plays a fundamental role'.

Connections, connections.....?