Perfect 2×2 Space -Time Block Codes via Quaternion Algebras over Number Fields

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In the same way as lattices can be constructed from a number field $\mathbb{K}$ by considering integral ideals in the ring of integers of $\mathbb{K}$, it is possible to construct lattices by considering integral ideals in a maximal quaternion order defined over number fields. This algebraic construction of lattices in dimension $4n$ as the image of an embedding of a quaternion algebra in $\mathbb{R}^{4n}$ restricted to an ideal contained or equal to a maximal quaternion order and it is possible to identify their volume, generator matrix and minimum norm. This structure also can be used to construct 2×2 STBC's (space-time block codes) in MIMO (multiple-input multiple-output) systems. The construction proposed are efficient for obtaining lattices with good center density which is desired when we use Gaussian channels and the codes obtained have maximum diversity which is desired in fading MIMO channels.

This work aims to present the construction of perfect 2×2 space-time block codes built by using lattices from a quaternion algebra over number fields. This code is said to be perfect because it is of full rate and full diversity, has non-zero determinant, which allows a lower bound for the minimum determinant, and has cubic shaping constellation. We will compare the codes constructed with the Alamouti's code, the precursor to STBC's, the golden code and the silver code.