Complex Orthogonal Designs with Forbidden 2×2 Submatrices

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Complex orthogonal designs (CODs) are used to construct space-time block codes. COD $\mathcal{O}_z$ with parameter $[p, n, k]$ is a $p \times n$ matrix, where nonzero entries are filled by $\pm z_i$ or $\pm z^*_i$, $i = 1, 2,..., k$, such that $\mathcal{O}^H_z \mathcal{O}_z = (|z_1|^2+|z_2|^2+...+|z_k|^2)I_{n \times n}$. Define $\mathcal{O}_z$ a first type COD if and only if $\mathcal{O}_z$ does not contain submatrix {$\pm z_j$ & 0; \ 0 & $\pm z^*_j$} or {$\pm z^*_j$ & 0; \ 0 & $\pm z_j$}. It is already known that, all CODs with maximal rate, i.e., maximal k/p, are of the first type.

In this paper, we determine all achievable parameters $[p, n, k]$ of first type COD, as well as all their possible structures. The existence of parameters is proved by explicit-form constructions. New CODs with parameters $[p,n,k]=[\binom{n}{w-1}+\binom{n}{w+1}, n, \binom{n}{w}]$ for $0 \le w \le n$, are constructed, which demonstrate the possibility of sacrificing code rate to reduce decoding delay. It's worth mentioning that all maximal rate, minimal delay CODs are contained in our constructions, and their uniqueness under equivalence operation is proved.

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